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Main Findings

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Lake Couchiching Environmental Quality - 1997

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SUMMARY

Introduction

Lake Couchiching is part of the Trent-Severn Waterway, connecting Lake Ontario with Georgian Bay. Water enters the lake from Lake Simcoe at Atherley Narrows and flows north. Lake Couchiching (latitudes 44°36' to 44°45' N; longitudes 79°20' to 79°25' W) has a surface area of about 33.75 km^2 (12,100 acres) and has 45 km (28 mi) of shoreline. One large island (Chiefs Island) and several smaller ones (Horseshoe, Heron and Garnet) comprise a land area of 0.84 km^2, with a total shoreline length of 14.6 km. The lake is shallow, with a maximum depth of 12 m (39 feet) and an average depth of 6 m (20 feet).

In response to concerns that the environmental quality of Lake Couchiching is under pressure from increasing recreational uses and development along its shores, this study was conducted to:

(i) establish a baseline database with respect to the lake's limnology, water, sediment and biological quality,
(ii) define the existing aquatic environmental quality and trophic status of Lake Couchiching (i.e., at the present level of development); and ,
(iii) develop recommendations concerning possible impacts associated with future development.

Based on these overall objectives, this study characterized water and sediment quality at several locations in Lake Couchiching. This study also characterized bacteria, phytoplankton, zooplankton, macroflora (macroalgae and macrophytes) and benthic macroinvertebrate communities. This study did not attempt to characterize the condition of fish populations in Lake Couchiching since the local Ministry of Natural Resources offices routinely update that information. The biological communities (phytoplankton, zooplankton, macroflora, and benthos) that are characterized in this study are however, capable of being used as early warning indicators of potential effects on fish populations in the lake. Surveys were conducted throughout the ice-free period in 1997.

Methods

Water quality was characterized every two weeks at four mid-lake stations, while samples were collected during late spring and mid summer at 17 stations located around the periphery of the lake. At the two deepest points in the lake (Stations 5 and 15), water samples were collected both 1 m below the surface, and 1 m off bottom (1 MOB). At all four mid-lake stations, dissolved oxygen and temperature profiles were determined to further examine the effect the sediments might have on dissolved oxygen concentrations. Surficial sediments and sediment cores were collected and examined for metals and organic compounds. Sediment cores collected historical sediments deposited in the lake. They thus provide a good baseline against which to judge current sediment contaminant concentrations. Zooplankton at the four mid-lake stations were counted and identified to species. Zebra mussels veliger larvae were also counted. Surveys of macroflora (plants/algae) and benthic invertebrates were made at the 21 stations.

Highlights

Basic Chemistry and Nutrients Status

Lake Couchiching is a basic, hardwater lake with high alkalinity (greater than 100 mg/L) and pH (above 8). The lake is therefore not susceptible to the effects of acidic precipitation. Based on nutrient chemistry, the lake is oligotrophic. Primary production in the lake is limited by phosphorus which was present at low concentrations. Where phosphorus is the limiting nutrient, the Ontario Ministry of Environment recommends that total phosphorus concentrations be kept below 0.020 mg/L to avoid nuisance growths of algae. Total phosphorus concentrations in the lake were typically less than 0.014 mg/L suggesting that nutrient concentrations are not high enough to cause nuisance growths of algae.

Concentrations of chlorophyll *a* in Lake Couchiching were low. Among the mid-lake stations, chlorophyll *a* concentrations ranged from 0.5 to 2.6 μg/L. Concentrations peaked in mid-July and were lowest through late August and September. Lakes with summer average chlorophyll *a* concentrations of between 2 and 5 μg/L are typically classified as mesotrophic. Based on the observed chlorophyll *a* concentrations, Lake Couchiching can be classified as oligotrophic to slightly mesotrophic.

Lake clarity can also be used to characterize nutrient status. Water clarity was measured by Secchi disc depths. In general, Lake Couchiching has good clarity: Secchi discs were visible on the bottom at all shallow nearshore stations. At mid lake, Secchi depths varied between 4 and 7 m and had increased from 1977. Lakes with a Secchi depths greater than 5 m are typically considered oligotrophic. Based on Secchi depth readings, Lake Couchiching can, therefore, be considered oligotrophic.

Bacteria

Bacterial counts were determined from water samples collected at each of the 21 stations during June and July. These samples were not in the vicinity of beach areas. Bacteria were detected infrequently and at low densities. The highest density or concentration of the indicator *Escherichia coli*, 36 organisms per 100 ml at Station 1 near Cedar Island, was well below the Provincial Water Quality Objective (PWQO) of 100 organisms per 100 ml for the protection of recreational water users. Faecal *Streptococcus* was detected at a maximum density of 18 , again at Station 1 near Cedar Point. There is currently no PWQO for numbers of faecal streptococci . The pathogen *Pseudomonas aeruginosa* was not detected in any of the samples. Based on these data, there is no apparent risk of infection by swimming in Lake Couchiching.

Taste and Odour Problems

Residents of Orillia have complained about poor taste and odour of municipal water supplies originating from Lake Couchiching. Taste and odour problems have been attributed to two compounds (geosmin, or 1,10-trans-dimethyl-trans-9-decalol, and 2-MIB or 2-methylisoborneol) that originate primarily in algae. Previous work had shown that algal densities in the water column of Lake Couchiching are below thresholds that would cause taste and odour problems. It has been suggested, however, that green and blue-green algae that reside on the bottom of the lake may be

partially responsible for the poor taste and odour. Indirectly, the introduction of zebra mussels to the lake may be responsible for the poor taste and odour. Where zebra mussels colonize, densities of benthic algae have been shown to increase. Zebra mussels have colonized virtually every location within the lake and this survey did document areas with extensive growths of algae.

Metals

Slices of historic sediments indicated that arsenic and some metals (e.g., lead, zinc, mercury, cadmium, copper) have increased in the lake's surficial sediments. Metal levels in water and sediment are, however, still at safe levels for aquatic life. Even though metal levels were low, there is still evidence that mercury is biologically available and biomagnifies in the aquatic food chain. Routine monitoring by the Ontario Ministry of the Environment shows that mercury levels in large smallmouth bass, largemouth bass, northern pike, walleye and yellow perch are elevated, and that there are consumption restrictions.

Organic Contaminants

Relative to concentrations in historical sediments, concentrations of oil and grease were slightly elevated in surficial sediments, especially in the vicinity of Orillia (Stations 1 to 4). However, since no petroleum hydrocarbons were detected, the oil and grease found near Orillia would appear to be from natural sources such as lipids and fats resulting from decomposing plant and animal matter. Atrazine was detected at "trace" amounts (i.e., less than 150 ng/L) in over half of the water samples, with most of the detections occurring along the western shore. Atrazine concentrations were less than levels required to pose ecological or human health risks. Atrazine is a herbicide used in the cultivation of corn, and is non-persistent in aquatic environments.

Polycyclic aromatic hydrocarbons (PAHs) were detected at low concentrations in a few of the Lake Couchiching surficial sediment samples. PAHs were detected primarily in the south-west end of the lake near Orillia. With one minor exception, concentrations of the individual compounds, as well as total PAHs were below the respective Provincial Sediment Quality Low Effect Levels (i.e., concentrations at which there is the potential to affect 5% of the sediment-dwelling biota). Persistent organic contaminants including polychlorinated biphenyls (PCBs), organochlorine pesticides, phenoxy acid herbicides, chlorinated phenols, and chlorinated aliphatics and aromatics were not detected in any of the surface sediment samples. Organic contaminants in Lake Couchiching, therefore do not pose ecological or human health risks.

Phytoplankton (Algae)

The phytoplankton were represented by 54 genera. Communities were generally similar among the mid-lake stations, reflecting relatively homogeneous water quality across the lake. At all stations, biovolumes of phytoplankton were low ($<350{,}000\ \mu m^3/ml$). No nuisance levels of algae were observed. The dominant algae in Lake Couchiching were those typical of oligotrophic (low nutrient) conditions including the diatom *Cyclotella* sp.

Zooplankton

Zooplankton were represented by 15 species. Zebra mussel veliger larvae were also recorded in the

plankton. The zooplankton were composed primarily of calanoid and cyclopoid copepods and non-daphnid cladocerans (*Bosmina longirostris*). The zooplankton community was also characteristic of oligotrophic conditions with a low biomass ranging between 5 and 37 mg/m^3 and peaking at only 80 mg/m^3. In this survey, zebra mussel veliger larvae were first observed on June 17. On July 9, veliger larvae exceeded the biomass of other zooplankters. Of a total zooplankton biomass of about 18 mg/m^3, veligers constituted about 14 mg/m^3 of the total, with a density of over 16,000 veligers per m^3. Through the remainder of the summer, veligers gradually fell in importance from about 40% of the zooplankton biomass to about 20% by the end of August. Veliger densities were strongly associated with water clarity, with peak densities occurring during the spring clear-water phase evident through June and July.

Macroflora
In Lake Couchiching, the macroalga *Chara* was the single most dominant form. It was a dominant bottom feature at all shallow-water (< 7 m) stations, but was absent at the two deepest stations (5, 15). When found, beds of *Chara* were up to 50 cm high. *Vallisneria americana*, (tape grass, wild celery), *Utricularia vulgaris* (bladderwort), *Najas flexilis* (bushy pondweed) and *Potamogeton richardsonii* (Richardsons pondweed) were also present at many stations. Broadleaf forms of *Potamogeton* (*P. amplifolius*), *Elodea canadensis* (common waterweed) and *Myriophyllum* sp. (Eurasian Water Milfoil) were found at a few stations each.

The filamentous green alga *Spirogyra* was common in the south portion of the lake. This plant was growing on (fouling) the aquatic macrophytes and *Chara sp.* beds. Large billowy clouds of this alga were present on the sandy substrates near the breakwalls around the marina at Orillia and in the bay areas between the marina and the Narrows near the incoming flows from Lake Simcoe. Previous studies of plants did not document significant growths of this alga. Large growths of filamentous green algae can result in water quality problems, including loss of recreational potential (i.e., swimming) and loss of habitat for fish and wildlife (fouling of plant beds and bottom substrate). Large amounts of *Spirogyra* and other filamentous green algae have the potential to reduce dissolved oxygen levels during the night.

In 1972, *Myriophyllum* was the most dominant (79% of stations) and abundant plant form. In 1997, *Myriophyllum* was not abundant or prevalent, being found at only a single station (19) at the inflow of Lake Couchiching. In 1972, the species of *Myriophyllum* was probably *M. spicatum* (or Eurasian Water Milfoil). This exotic plant clogged several lakes in Southern Ontario with growths impeding the operation of water craft. The decline in abundance of *Myriophyllum* in Lake Couchiching is not unusual. Since the early 1970s, *Myriophyllum* has declined or disappeared from other lakes in Ontario and the north western United States.

Benthic Communities
The benthic community was represented by 96 taxa from 22 major invertebrate taxonomic groups. In general, sediments at most stations contained the common amphipod *Hyalella azteca*, a good variety of chironomids (midges), the mayfly *Caenis punctata*, a few Leptoceridae (caddisflies), an assortment of gastropod molluscs (snails) and a large number of the bivalve mollusc *Dreissena*

polymorpha (i.e., zebra mussels). The generally uniform substrate of silty sand, with a high mollusc shell content and dense mat of the aquatic plant *Chara* was probably responsible for the generally uniform benthos. Total numbers of benthos (including zebra mussels) ranged from just over 7,000 m^{-2} to just under 100,000 m^{-2}, while the number of taxa per sample ranged from 14 to 28.

Adult zebra mussels were found at all stations in abundances ranging as high as 60,000 m^{-2}. Most of these zebra mussels were associated with *Chara,* actually being attached to the macroalga. So far, abundances of zebra mussels in Lake Couchiching are not extraordinary. Zebra mussel populations have exceeded 200,000 m^{-2} on hard substrate in Lake Erie, but are typically lower (10,000 m^{-2}) on soft substrate.

The date of entry of zebra mussels into the lake has not been confirmed. However, some of the limnological characteristics of the lake may already reflect the effect of zebra mussels. For example, an increase in water clarity from 1977 to 1997 could be attributed, in part, to the introduction of zebra mussels. To document the arrival of zebra mussels, the Ontario Ministry of Natural Resources has conducted surveys of zebra mussel veliger larvae (the free-swimming stage) for several years but has not published the findings of those studies.

The benthic fauna of Lake Couchiching generally reflected a slightly mesotrophic condition. The presence of Orthocladiinae chironomids (especially *Epoicocladius*), and the Tanytarsini chironomids *Stempellina* and *Zavreliella* suggest relatively high water quality since these taxa are sensitive to eutrophication. The most dominant chironomids included *Chironomus, Dicrotendipes, Paratendipes, Tanytarsus*, and *Procladius*. All but *Tanytarsus* are reasonably tolerant of oxygen deficits. Finally, mesotrophy can be assumed based on the abundances of organisms at all stations. Typically, oligotrophic lakes can support only up to about 2,000 benthic organisms m^{-2}. In Lake Couchiching, numbers were generally in excess of about 20,000 m^{-2} suggesting at least a slightly mesotrophic condition.

The composition of benthic invertebrate communities in the lake was relatively homogeneous, with a few exceptions. Deep-water communities (Stations 5 and 15) did have more fingernail clams (*Pisidium*), snails (*Helisoma anceps*) and phantom midges (*Chaoborus*) than did shallower sites. Station 19 near the inflow from Lake Simcoe had larger populations of aquatic sowbugs, and valvatid snails than other locations. Fauna from this station may reflect the cooler waters from Lake Simcoe. Finally, Stations 16 (near the YMCA discharge at Geneva Park) and 18 (at the mouth of Sucker Creek , into which Fern Resort discharges) had large populations of midge larvae (Chironomidae) indicating moderate impairment.

Trophic Status

The lake can be classified as either oligotrophic or moderately mesotrophic based on the good water clarity, low nutrient concentrations, and a suite of organisms (phytoplankton, zooplankton, benthos) that are typically associated with oligotrophic and slightly mesotrophic conditions. Oligotrophic lakes are the most desirable from a recreational standpoint because of the high clarity. They also tend to support large sport fish because oxygen concentrations are high throughout the year, even in

deep water. Mesotrophic lakes are characterized by moderate growth of algae and aquatic plants. They are suitable for the pursuit of water-oriented recreational activities but have the potential to develop periodic algal blooms.

Recommendations

The third objective of this report is to provide recommendations concerning possible impacts associated with future development. With increasing development, there is the potential for alterations in water quality to occur. Some of the more significant sources of water quality impairment include:

i) soil erosion and sedimentation from construction activities
ii) increased contaminant, bacterial, and suspended solids loadings from storm-water runoff
iii) increased phosphorus loadings from future development (municipal sewage)
iv) streambank erosion in new developments
v) introduction of exotic species
vi) loss of aquatic habitat through shoreline development

Based on the predicted impacts of development and on the results of the survey, the following recommendations are made.

Recommendation 1: Further confirmation and investigation of sites where impairment was demonstrated.

Biological impairment was evident at Station 16 and at Station 18. Further confirmation and investigation of impairment at these two locations by the Ministry of the Environment is warranted.

Recommendation 2: Implement appropriate management practices to minimize water quality impairment

Water quality impairment from development can be minimized through proper planning, education and mitigation. In this regard, the Ministry of the Environment is conducting meetings with Municipalities, conservation authorities and consultants in Simcoe County.

Recommendation 3: Develop a monitoring program to track long-term changes due to the trophic status of the lake.

In order to assist area municipalities in making prudent planning decisions, the Ministry of the Environment will conduct periodic biological and chemical monitoring in Lake Couchiching.

ACKNOWLEDGEMENTS

The Project Managers for this study were Bruce Hawkins and Peter Kauss. This study was designed by Bruce Hawkins, Peter Kauss, John Westwood, Andy Gemza, and Rein Jaagumagi. Technical field assistance was provided by crew chiefs Greg Hobson and Wendy Page, Captain Dave Brandreth of the Ministry of the Environment survey vessel Monitor VI, and students Brian Thorburn and Melissa Krausse. Water and sediment chemistry analysis was performed by the Ontario Ministry of the Environment Laboratory Services Branch in Etobicoke. Zooplankton counts and identification were performed by Beroe consultants, while counts and identification of benthic macroinvertebrates were performed by Bill Morton. The report was compiled and edited by Bruce Kilgour, with contributions from Peter Kauss (water and sediment chemistry), Andy Gemza (water chemistry, phytoplankton and zooplankton from the mid-lake stations) and John Westwood (macroflora). Bruce Kilgour analyzed and interpreted the benthic community data.

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Background

1.0 BACKGROUND

1.1 Lake Setting and Characteristics

Lake Couchiching derives its name from the native peoples, who referred to this lake as "Lake of Many Winds". Lake Couchiching is part of the Trent-Severn Waterway, connecting Lake Ontario with Georgian Bay (Figure 1). Water enters the lake from Lake Simcoe at Atherley Narrows and flows north. Located in Simcoe County (Latitudes 44°36' to 44°45' N; Longitudes 79°20' to 79°25' W), the lake is bordered by the Townships of Orillia, Rama and Mara, which together encompass an area of about 72,000 hectares; of this, 64.44 km^2 drains into Lake Couchiching (Cumming Cockburn, 1992). Geologically, the land immediately surrounding Lake Couchiching varies considerably, ranging from a sand plain adjacent to the west and south shores, to a clay plain dotted with drumlins along the lower eastern shore in Mara Township, which is separated by a limestone plain from the Canadian Shield along the upper half of the east shore (Chapman & Putnam, 1966).

Lake surface area and shoreline length are about 44.75 km^2 (12,100 acres) and 45 kilometres (28 miles), respectively (Jones & Veal, 1972). One large island (Chiefs Island) and several smaller ones (Horseshoe, Heron and Garnet) comprise a land area of 0.84 km^2, with a total shoreline length of 14.6 km.

Lake Couchiching is relatively shallow, with a maximum depth of 12 m (39 feet) and an average, or mean, depth of 6 m (20 feet). The deepest areas are located at: roughly the midpoint of the lake, halfway between Amigo Beach and Quarry Bay; and from just south of Horseshoe Island to near Orillia. Nevertheless, the shallowness of the lake prevents any significant thermal stratification during the summer.

Apart from the Lake Simcoe inflow to the lake at Atherley Narrows (Figure 2), tributaries to Lake Couchiching are relatively small. They include: Sucker Creek, on the east shore near Garnet Island; an unknown creek on the west shore, opposite Chiefs Island; Robinsons Creek at Amigo Beach, with two discharge points; and another unknown creek on the west shore, opposite Green Island. Outflow of Lake Couchiching to Lake Huron is through three channels at its northern end: the Severn River, with two branches; and the Trent Canal.

1.2 Historical Environmental Information

Available water quality data for Lake Couchiching is largely out-dated, dating back to the late 1970's. During June of 1972, dissolved oxygen and temperature profiles were determined by the Ministry of Natural Resources (unpublished data). Between late June and late August of 1977, the Ontario Ministry of Environment characterized dissolved oxygen, temperatures and other basic water quality parameters (unpublished data). Between 1971 and the end of 1993, water quality information was obtained through the Ministry of the Environment's Provincial Water Quality Monitoring network at both the inflow and outflow of the lake: samples were collected monthly at both the inlet (Highway 12, at Atherley) and outlet (Highway 169, at Washago) of the lake. In addition, the inflow water quality to the lake has been monitored bi-weekly since 1990, as part of the Lake Simcoe Environmental Management Strategy. Flow rate has been monitored by the Water Survey of Canada at several discharge points of the lake since 1963, but only water level is recorded at the inlet to the

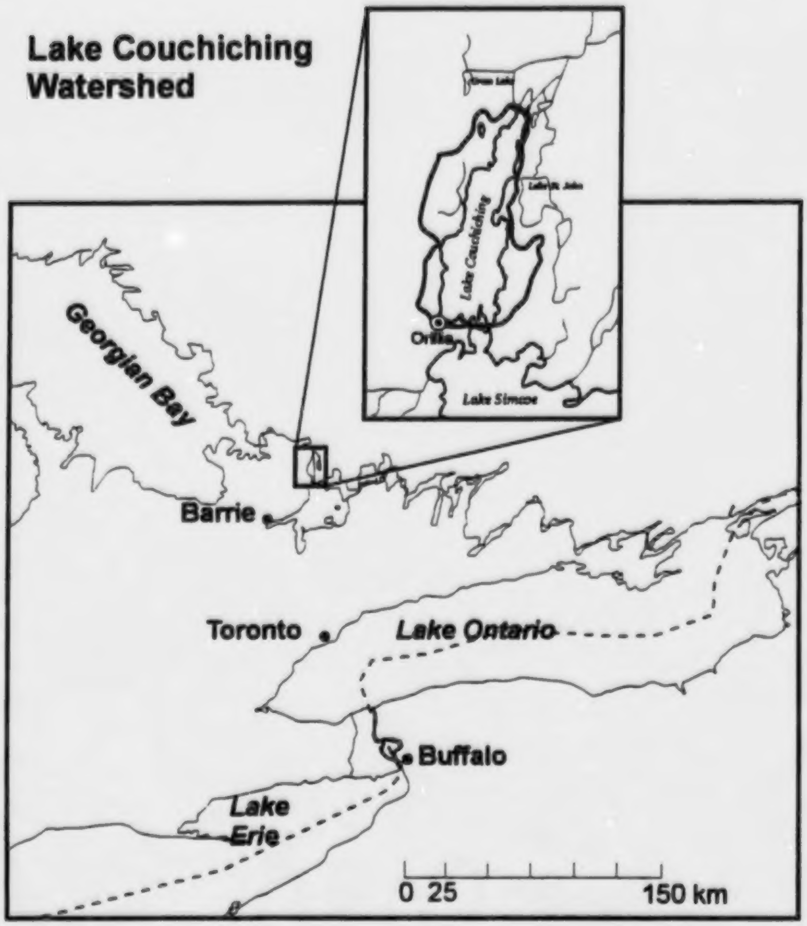

Figure 1. General location of Lake Couchiching and its catchment.

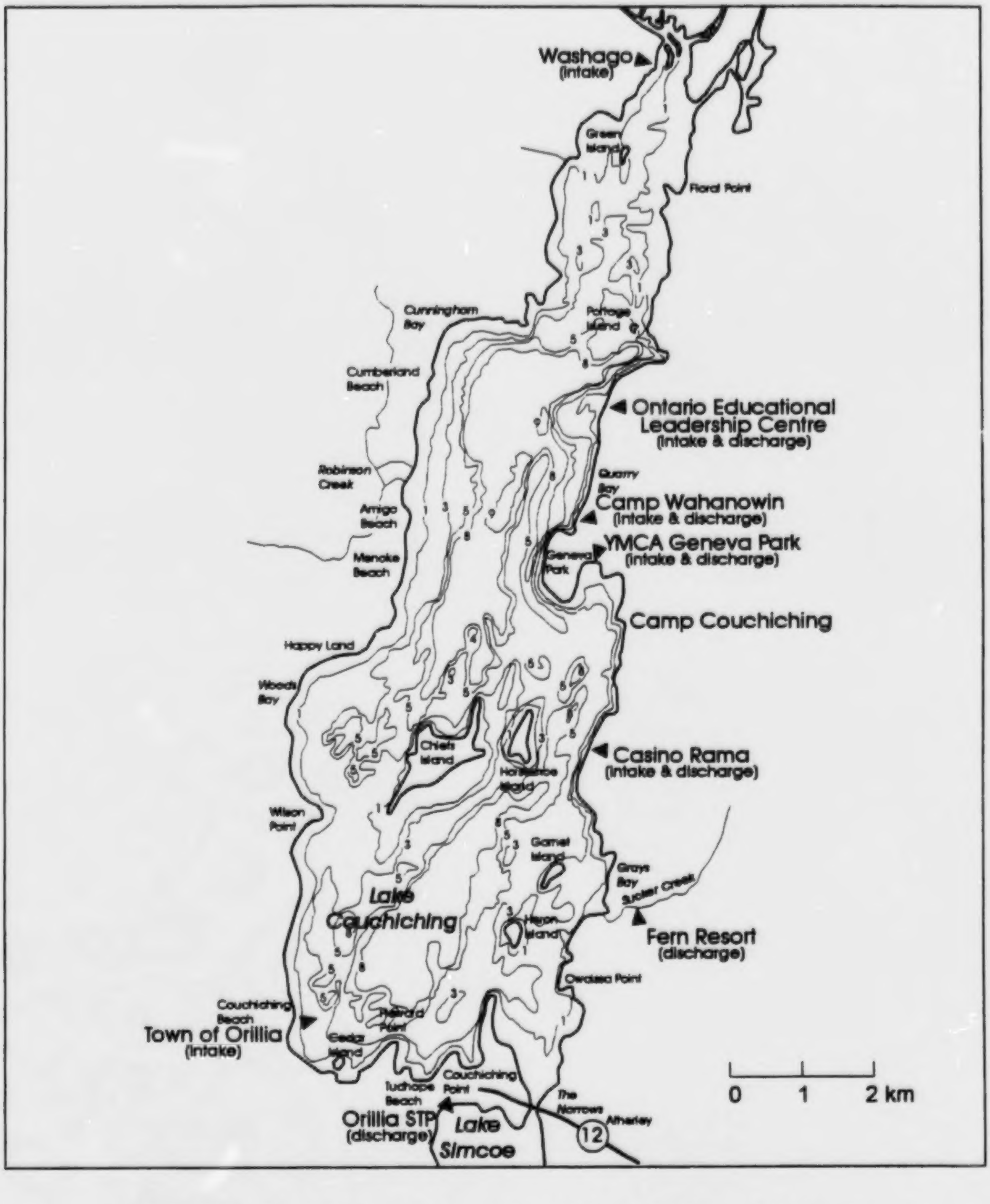

Figure 2. Map of Lake Couchiching showing points of interest, intakes and discharges, and depth contours (m).

lake by Environment Canada. The latter data were used to derive an estimated long-term (1963 to 1990) average Lake Simcoe discharge to Lake Couchiching of 28.63 m^3/s, as well as the export of nitrogen and phosphorus from Lake Simcoe (Cumming Cockburn, 1992).

Some biological surveys have been conducted on Lake Couchiching. The earliest study of aquatic plants was conducted at 86 stations by OMOE in July, 1972 (Jones and Veal 1972). This revealed a large standing stock of aquatic macrophytes in the shallow waters (<8 m depth) of the lake, with the major species in decreasing importance being *Chara*, tapegrass (*Vallisnaria americana*), Eurasian Water Milfoil (*Myriophyllum* spp.) and different pondweeds (*Potamogeton* spp.).

Biological monitoring of persistent contaminants was conducted by the Ontario Ministry of the Environment in 1996. Young-of-the-year yellow perch were collected from the lake at three nearshore locations in the lake (upper, middle eastern and bottom). Analysis of PCBs and organochlorine pesticides did not find any concentrations above guidelines for the protection of higher trophic levels (i.e., larger fish or fish-eating birds; G. Hitchin, Ontario Ministry of the Environment, pers. comm., 1998).

Being shallow, Lake Couchiching supports a warm-water fishery. Key recreational species include walleye, largemouth and smallmouth bass, northern pike and yellow perch. Persistent contaminants in sport fish have been monitored over the years by the Ontario Ministry of the Environment. Currently, restricted consumption advisories for humans are in effect for larger sizes of smallmouth bass, largemouth bass, walleye, northern pike and yellow perch due to mercury levels above safe levels (>0.5 mg/kg). PCB concentrations in the dorsal fillets are, however, at safe concentrations set by Health Canada (<0.5 mg/kg, OMOEE, 1997).

1.3 Current Land and Water Uses

Land in the Lake Couchiching watershed is used for agriculture. A number of insecticides, fungicides and herbicides are used on the field fruit and vegetable crops. Of the latter, phenoxy acid and triazine herbicides predominate (Hunter and McGee, 1994).

Washago, Orillia, Ontario Educational Leadership Training Centre, YMCA Geneva Park, Camp Wahanowin and Casino Rama have drinking water intakes in the lake (Figure 2). Of the discharges to the lake (Figure 2 and Appendix A), those of Casino Rama include a continuous discharge from a sewage treatment plant as well as effluent from a wetland stormwater treatment facility. Discharges from the Ontario Educational Leadership Training Centre, YMCA Geneva Park, Camp Wahonowin and Fern Resort are seasonal.

Public and private beaches are located all around Lake Couchiching (Figure 2). The Simcoe County Department Health Unit in Midhurst regularly monitors bacterial densities at Washago Park, Couchiching Beach Park, Tudhope Beach, Fern Resort, Camp Couchiching, Geneva Park, Camp Wahonowin and the Ontario Student Leadership Camp. Levels of faecal coliform bacteria (the bacteria associated with health risks) have routinely been low (Katona, 1998).

Urban development is largely concentrated in Orillia, although a number of smaller communities are

scattered around the shoreline (Figure 2). Concerns related to water quality impacts have been expressed regarding an increase in development around Lake Couchiching in recent years. Most notable was the construction of the Casino Rama complex and associated developments on the east shore of the lake. This led to requests being received by Southwestern Region of the Ontario Ministry of the Environment from the local municipalities and from the Ministry's District Office in Barrie for a whole-lake environmental characterization.

Residents of Orillia have complained about poor taste and odour of municipal water supplies originating from Lake Couchiching. Taste and odour problems have been attributed to two compounds (geosmin, or 1,10-trans-dimethyl-trans-9-decalol, and 2-MIB or 2-methylisoborneol) that originate primarily in algae. Previous work has shown that algal densities in the water column of Lake Couchiching are below thresholds that would cause taste and odour problems (Katona, 1998). It has been suggested, however, that green and blue-green algae that reside on the bottom of the lake may be responsible for the poor taste and odour.

Study Objectives

2.0 STUDY OBJECTIVES

Based on the extensive recreational use of the lake, the increased level of development along its shores, and poor water quality (for consumption), this study had the following objectives:

(i) to establish a baseline database with respect to the lake's limnology, water, sediment and biological quality,

(ii) to define the existing aquatic environmental quality and trophic status of Lake Couchiching (i.e., at the present level of development); and,

(iii) to develop recommendations concerning possible impacts associated with future development.

Based on these overall objectives, this study characterized water and sediment quality at several locations in Lake Couchiching. This study also characterized bacteria, phytoplankton, zooplankton, macroflora (macroalgae and macrophytes) and benthic macroinvertebrate communities. This study did not attempt to characterize the condition of fish populations in Lake Couchiching since the local Ministry of Natural Resources offices routinely updates that information. Phytoplankton, zooplankton, macroflora, and benthos are however, capable of being used as early warning indicators of potential effects on fish populations in the lake. Surveys were conducted throughout the ice-free period in 1997.

Methods

3.0 METHODS

3.1 Preliminary Lake Reconnaissance

On May 6, 1997 a reconnaissance survey was conducted by staff from the Ontario Ministry of the Environment to determine the nature of sediments and the benthic habitat of the lake. In all, 19 locations were sampled, using a Ponar grab. Water depth, grab fullness, sediment characteristics and any flora and fauna present were noted and recorded. This information (Appendix B) was used to select the areas and stations to be sampled later for water quality, sediment quality, benthic communities and aquatic plants.

Based on the results of the reconnaissance survey, 21 stations were selected for sampling. Of these 21 stations, four were situated at roughly mid-lake positions (Stations 5, 12, 15, 21). Stations 5 and 15 were considered to be indicative of whole lake quality. Station locations and map coordinates, are listed in Appendix C and shown in Figure 3. Discrete sampling locations were fixed using an on-board computer equipped with a navigation software package *Hydro®*, interfaced to a Trimble® differential global positioning system (GPS). This permitted an on-board visual display of when the station location had been reached.

3.2 On-Board Water Quality Measurements

Prior to the collection of water samples in June and July, spatial variations in chlorophyll, conductivity and temperature were determined by following a pre-determined course around the lake and using on-board metres. A Chelsea Aquatracka Model 3 UV-fluorescence metre was used to determine chlorophyll concentrations and a Hydrolab Datasonde unit for the remaining measurements. Data was stored in an on-board computer interfaced to the Trimble® differential global positioning (GPS) unit and plotted with the navigation software package *Hydro®*.

Concurrent with water quality sampling during the June and July surveys, water temperature, conductivity, pH, and dissolved oxygen were also measured at ~1 metre depth increments, using a pre-calibrated Hydrolab Datasonde unit. Data was stored in an on-board computer interfaced to a Trimble® differential GPS unit.

Depth of visible light penetration was determined with a Secchi disc at each station. Also, Photosynthetically Active Radiation (400-700 nm) was profiled with a LI-COR model LI92SA Underwater Quantum Sensor connected to a LI000 DataLogger. At the three deepest stations (5, 15 and 17), the light extinction coefficient was calculated from a plot of the transmitted light fraction in relation to depth.

3.3 Current Metering

Current speed, current direction and water temperature were measured during the water quality survey in early June to provide information on the flow structure within the lake, as well as the velocities nearer the shore (e.g., near some of the beach locations). Locations of these 25 stations (Appendix C) were somewhat different from those used for water and sediment quality sampling. At each station, one or two Mini-Aanderaa Model SD-2000 metres (set to record at the minimum time interval of 8 minutes) were deployed to measure current velocity and direction for 45 minutes. At locations where major flows were anticipated (e.g., between islands), the metres were left in for

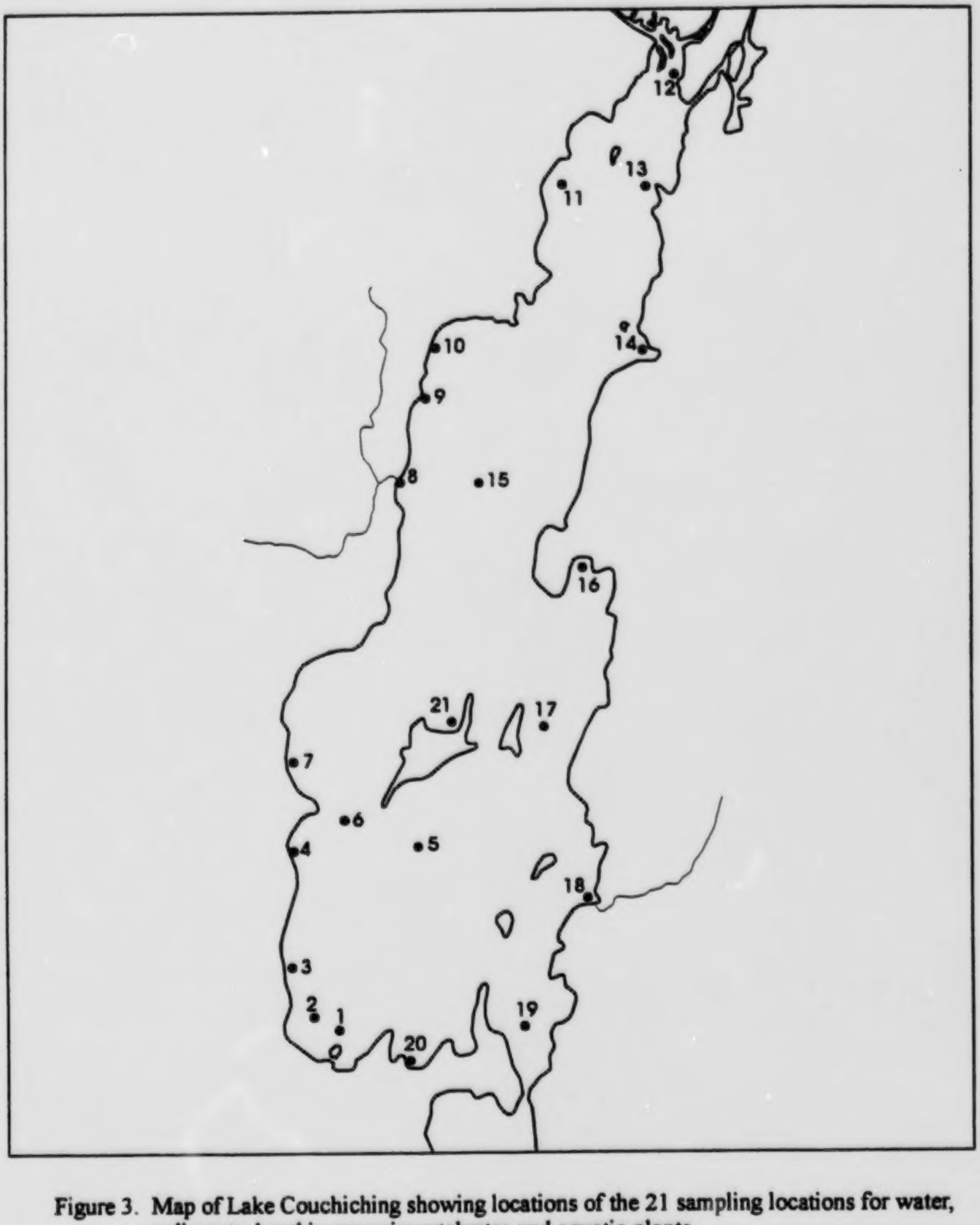

Figure 3. Map of Lake Couchiching showing locations of the 21 sampling locations for water, sediments, benthic macroinvertebrates and aquatic plants.

a longer time period (e.g., several hours or overnight). At each station, the meter(s) were attached to a weighted line with a marker buoy and deployed at 1 metre below surface (or 20 % of the water depth, whichever was greater) and at 1 metre above the bottom (or 80 % of the water depth, whichever was the shallower). At stations of less than 3 m water depth, the current meter was deployed only at mid-depth. The deployment and retrieval times were recorded for each meter and station depth, along with any other pertinent observations. Data recorded by the meters was later downloaded for interpretation.

During the May 28-June 2 surficial sediment quality sampling, current speed was also determined at approximately 0.2 m above bottom at each station, using a Marsh-McBirney meter, while the survey vessel was anchored. Measurement period was at least 30 minutes, with a minimum of three data points being recorded during that period.

3.4 Water Quality

3.4.1 Spatial Variation

To characterize spatial variation in water quality, water samples were collected at the 21 stations (Stations 1 to 21, Figure 3) in late spring (June 3) and summer (July 7-8). Most of these stations were situated around the periphery of the lake. Stations included potentially impacted (e.g., urban development, with point source discharge) and unimpacted (i.e., undeveloped) areas, and four open-water sites. Analyses carried out on the water samples are provided in Appendix D. Due to analytical capacity limitations, chlorophenols, phenoxy acid herbicides and triazine herbicides could only be analyzed for on samples from the June 3 survey.

On each survey, grab water samples were collected from 1 metre below the surface, using a March Model 5C MD submersible pump and Teflon®-lined hose system that had been cleaned with hexane and distilled water before the beginning of each day's sampling. Once on station, the pumping system was flushed for five minutes with lake water prior to actually taking samples. Except for those bottles that had been pre-cleaned or which already contained a preservative, sample containers were rinsed twice with sample water before filling.

In addition to the routine sample collections, on each survey two additional replicate samples were collected at two stations randomly selected from the total of 21 and submitted for <u>all</u> analyses except bacteria. Data from these samples was used to provide information on sample handling, analytical reproducibility, and short-term temporal variability. To obtain information on potential field and sample container effects, one set of field procedural blank samples was also obtained for each survey by pouring distilled water through the collection system and submitted for <u>all</u> analytical requests except bacteria. To provide data on potential sample container effects, one set of distilled water travel blanks was obtained by filling the required bottles for <u>all</u> analytical requests except bacteria at the laboratory and transporting them to the field and back.

3.4.2 Temporal Variations

Of the 21 water quality stations, four located in a line up the centre of the lake (5, 12, 15, 21; Figure 3) were selected for more detailed analysis of trends through time and variations with depth. At these stations, water samples were collected approximately bi-weekly between June 3 and October

23, 1997. These four stations were selected because they were considered to represent general lake quality. To determine whether sediment nutrient release may be taking place, samples from 1 metre off bottom (1 MOB) were also retrieved at the two deeper stations (5 and 15). Euphotic zone samples were collected by lowering and raising a weighted narrow-mouthed (2 cm) glass bottle through the water column. The bottles were lowered through two times the measured Secchi disc depth to a maximum of 1 MOB. Samples from 1 MOB were retrieved by activating a 6-litre, Kemmerer sampler at depth.

Sub-samples for water chemistry were transferred from the collection bottles or sampler to the required sample containers and preserved following OMOE (1989) procedures. Samples were then analyzed for metals, chlorophyll and nutrients (Appendix D). Oxygen and temperature profiles were determined using an air-saturated calibration of a YSI Model 58 combination dissolved oxygen and temperature probe.

3.5 Sediment Quality

Between May 29 and June 2, surficial sediment samples were collected at each of the 21 stations (Figure 3). At each station, sufficient surficial sediment (upper 5 cm) was collected using a stainless steel Ponar grab. Between stations, the Ponar was rinsed with hexane and distilled water to eliminate potential cross-contamination. At all but two stations, three replicate surficial sediment samples were obtained, composited and homogenized in a hexane and distilled water rinsed stainless steel tray. At the remaining two randomly-selected stations, the three replicates were processed separately to provide estimates of within-station spatial variability.

On June 4, four replicate core samples were collected from each of the two deeper stations (5 and 15) using a Hobson-Benthos corer and 6.7 cm ID plastic core tubes of about 1 m in length. Each tube and end caps were pre-cleaned with hexane and lake water before use. The cores were brought back to shore, where they were individually sectioned at 0-5 cm (the surface layer), followed thereafter by 10 cm intervals (i.e., 5-15 cm, 15-25 cm, etc.). For each core section, the four replicates were then composited and homogenized as described above for the surficial sediment grabs.

While still on site, a subsample of each sediment composite or replicate was weighed using a small glass jar of known volume. The remaining material was then distributed among the required sample jars/containers and preserved as required (OMOE, 1989). With sediment core sections from stations 5 and 15, all but trace organic contaminants were analyzed for (Appendix E), pending receipt and review of the surficial sediment data. All surficial sediment grab samples were analyzed for nutrients, particle size distribution, oils and greases, total petroleum hydrocarbons, heavy metals, and organic contaminants (Appendix F). Sufficient extra sediment from each surficial sediment or core depth increment was put in an amber (trace organics) jar labelled with the station number, field sample number, and was kept frozen (-20°C) until all laboratory analyses had been received and reviewed.

3.6 Laboratory Analytical Methods

Water and sediment samples were submitted to the Ministry laboratories in Etobicoke and analyzed according to documented procedures (OMOEE, 1993; OMOEE 1994a; OMOEE, 1994c-d; OMOEE 1995a-c).

3.7 Plankton

At the four mid-lake stations (5, 12, 15, 21), plankton abundance and species composition were monitored approximately bi-weekly, between June 3 and October 23.

Phytoplankton

Only Station 5 was sampled bi-weekly to characterize temporal variation. For the three remaining mid-lake stations, bi-weekly algal samples were pooled for an annual "recombined" analysis to assess spatial variation and to provide an inventory of species. Samples were collected by allowing a weighted 1-L bottle with a restricted inlet to fill as it was lowered and raised through the euphotic zone (twice the Secchi disc depth). Samples were immediately fixed with Lugols solution, and transported to the OMOE laboratory on Resources Road. Phytoplankton samples were analyzed according to Gemza (1995a).

Zooplankton

Only Station 5 was sampled bi-weekly, to assess temporal changes and to obtain a species inventory. Samples were collected using a metered Clarke-Bumpus style conical net (80-μm mesh) lowered to 1 m above bottom and then retrieved to the surface at a fixed rate. The sample was rinsed from the net into a 4 oz. glass jar, preserved with 4 % sugared formalin and stored for later analysis as described by Gemza (1995b).

3.8 Macroflora

Macroflora were characterized visually at the 21 stations on July 7. On August 6 and 7, grab samples of macroflora were collected at each of these stations. The macroflora sampling in August was conducted with the use of a grapnel employing a modified approach of methods outlined by Schloesser and Manny (1984). The five-hook grapnel was 40cm long and 27cm in diameter. The grapnel was lined with 1cm square wire mesh.

The grapnel was dragged behind the boat at a slow, constant speed so that the grapnel remained on the bottom substrate. Three 10 m long hauls were collected at each sampling station. The abundance of plants on the grapnel was recorded by the collector (subjectively) as: H- heavy (grapnel obscured by plant bio-mass); M-moderate (grapnel wire mesh screen covered with plant bio-mass); P-present (grapnel wire mesh screen less than covered with plant biomass); and, V- void (no plant biomass). The plants were identified in their order of dominance (by volume) on the grapnel. Macrophytes and macroscopic algae were identified following Fassett (1957), Newmaster et al (1997), and Schloesser (1986). A reference collection of plants was made and is retained at the London Regional Office of the Ministry of the Environment.

In addition to these observations made at specific sampling points, a depth sounder (Lowrance X16 sonar unit with paper graph recording) was used to characterize distributions of macroflora with depth along three transects (Appendix C):

1)-From Cunningham Bay on the west shore to the north tip of Geneva Park on the east shore.
2)-From Maniac Beach (south) on the west shore to south of Geneva Park on the east shore.
3)-From the Nathan area on the west shore to Garnet Island near the east shore.

The transects were started at the 1-m depth contour on the west shore and were continuous to their termination on the east shore.

3.9 Benthic Macroinvertebrate Community

Benthic fauna associated with surficial sediments were also collected during the May 29-June 2 surficial sediment quality survey at each of the 21 sediment sampling stations (Figure 3). Three replicate samples were obtained by stainless steel Ponar grab at each station and individually sieved through a 600-μm mesh Nitex bag using clean lake water. Organisms and detritus retained in the bag were preserved with buffered formalin in wide-mouth plastic jars with a screw cap. For each grab, the percentage fullness of the Ponar grab, the percentage macrophyte cover and species present, the sediment characteristics and any obvious fauna were recorded on the field note sheets (Appendix K).

At each station, a fourth replicate Ponar grab was collected and placed directly in a covered plastic pail. These samples were picked up by staff of the Ministry's Aquatic Sciences Section in Dorset for processing (picked live) according to the Rapid Bioassessment protocol (David *et al.* 1998). These data have been reported separately (David *et al.*, 1998).

Analysis and Interpretation

Analysis and interpretation of the benthic community in Lake Couchiching had two general objectives:

- to establish trophic condition of the lake; and,
- to determine the degree to which local point sources, and natural features and anthropogenic features influence benthic community composition.

Known tolerances of benthic organisms were used to establish the trophic status of the lake. In addition, detailed statistical procedures were used to establish the associations between benthic community composition and local point sources and variations in habitat quality. The details of the various statistical and interpretational methods are given in Appendix J.

Results and Discussion

4.0 RESULTS AND DISCUSSION

This section reviews the general findings of the various sampling programs. The objective of this discussion is to highlight those findings that directly impact this characterization of environmental quality. In some cases, the data obtained led to very obvious conclusions and did not require excessive summary. For example, persistent chlorinated organic contaminants were not found in any sediment samples. Trends were therefore obvious, so no data summaries are provided in the main body of the report (Volume I). Most of the raw data collected in this study, however, is provided either in the main document, or in the appendices (Volume II). For conciseness, an attempt was also made to summarize the results of complimentary surveys. For example, temporal variations in water quality were characterized by collecting water samples at mid-lake stations every two weeks, while spatial variations in water quality were characterized by collecting water samples at stations located around the periphery of the lake in June and July. Data over time from the mid-lake stations could be used on their own to classify the lake trophically. Those temporal data are, however, discussed in association with the spatial surveys conducted in June and July at all stations to make a more concise and compelling discussion of lake trophic status. This section deals first with chemical and physical aspects of the lake, then biological aspects.

4.1 Lake Currents

Current velocities and directions were determined at the 21 stations during the late May-early June survey, but in more detailed fashion between June 4 and 6 at 24 "current" stations (Appendix C). This discussion focuses on the data from the 24 current stations. Current data are provided in Appendix D. In general, water currents in the lake were slow, averaging from 0.3 to 11.2 cm/s. Of these, the fastest currents were recorded at stations just off Couchiching Point (5.4 cm/s, near the bottom), off Wilson Point (5.9 cm/s), just north of Mariposa Beach (9.4 and 5.2 cm/s) and at Cedar Island (11.2 cm/s). Greatest short-term variability of current speed was usually observed at the deepest stations, located offshore and along the north-south axis of the lake, and off Woods Bay. Near Atherley Narrows, current speed was somewhat higher just off the bottom than just below the surface. Surface waters typically flowed west-northwest or north-northeast, but surface and bottom waters did not always flow in the same direction.

4.2 Water Quality

Variations in key water quality characteristics that are important to algae, zooplankton, benthos and fish are summarized below. Raw water quality data are presented in Appendix D.

4.2.1 Temperature and Dissolved Oxygen Profiles

By May 27, there was spatial variation in surface temperatures (8 to 14°C) with higher temperatures along the western half of the lake, particularly the nearshore area north of Orillia. By June 3 surface water temperatures averaged 16°C and by July 8 averaged 21°C. Mid-lake temperatures peaked on July 22 at 22°C, falling to 10°C on October 23 (Appendix D).

Because Lake Couchiching is relatively shallow for its size, the water column is usually fully mixed. Temperatures are, therefore, generally isothermal and dissolved oxygen concentrations remain high even near the bottom in deeper areas of the lake. Evidence for slight thermal stratification was evident at the deepest station (5) in early and mid June (Table 1). Oxygen concentrations were as

low as 6.2 mg/L in June, but ranged between 8.0 and 10.5 mg/L through the remainder of the summer (Table 1).

4.2.2 General Water Chemistry

Lake Couchiching is a basic, hardwater lake. At the four open water stations (5, 12, 15, 21), pH ranged between 8.2 and 8.4, while mean annual alkalinity levels ranged between 102 and 111 mg/L. Mean annual calcium concentrations ranged between 37 mg/L at station 12, to 41 mg/L at station 5. Alkalinity and calcium levels were marginally higher in the spring. At the mid-lake stations, conductivity was about 330 μS/cm (Table 1). Given the local geology, the lake is at no risk of effects from acidic precipitation.

4.2.3 Water clarity

Lake Couchiching had good water clarity; Secchi discs were still visible on the bottom of the lake at all of the shallow-water (2-3 m deep) stations. At the mid-lake stations, Secchi disc depth ranged between 4.0 and 7.0 m, with an annual mean of 5.1 m (Figure 4, Table 1). Peak Secchi depths representing the clear water phase were measured on June 17. Visibility declined through late August to the end of September with readings as low as 4.0 m. Based on these figures for Secchi disc depths, Lake Couchiching can be classified as either oligotrophic or mesotrophic. Vollenweider (1972; as cited in Wetzel, 1983) showed that lakes considered mesotrophic have an average Secchi disc depth of about 4.2 m but can range between 1.5 and 8.1 m. According to Carlton(1977), lakes with a Secchi dis depth greater than 5 m are oligotrophic, while those with Secchi disc depths between 2 and 5 m are mesotrophic. Water clarity in Lake Couchiching is also obviously adequate for swimming. Health and Welfare Canada (1983) suggests that Secchi disc depths should exceed 1.2 m to ensure that subsurface hazards can be observed.

Clarity in Lake Couchiching increased substantially between 1977 and 1997 (Figure 4). Based on the assumption that nutrient levels in the lake have not decreased since 1977, increased clarity in Lake Couchiching is probably associated with the presence of zebra mussels in the lake. Zebra mussels feed by filtering algae and bacteria from the water column (Stoeckmann and Garton 1997). In shallow lakes (like Lake Couchiching) it has been estimated that zebra mussel populations can filter the equivalent volume of a lake between 0.2 and 1.3 times daily (Fanslow et al. 1995).

4.2.4 Nutrient Chemistry

Several nutrients are important in determining the productive potential of algae, zooplankton, benthos and fish. In the discussion below, we focus on total phosphorus because the lake is phosphorus limited, and because lake trophic classification can be based on total phosphorus concentrations. Variations in chlorophyll *a* concentrations and silica were also summarized because they are both related to variations in phytoplankton abundances.

Total Phosphorus

In both the open lake and nearshore areas, the ratio of total nitrogen to total phosphorus (TN:TP) varied between 30 and 60 depending on the time of year (Figure 5, Table 1). Ratios in excess of 20:1 generally imply that phosphorus limits the production (growth) of algae (Wetzel, 1983; Smith, 1986). Phosphorus is therefore limiting in Lake Couchiching.

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Table 1. Water chemistry data representative of the general water quality of Lake Couchiching, 1997.

STATION 5	June 3	June 17	July 8	July 22	August 8	August 22	September 10	September 25	October 7	October 23	Mean
Euphotic Zone											
Secchi disc depth (m)	5.5	7.0	5.5	6.1	4.5	4.0	4.0	4.0	6.3	4.5	5.1
Chloride	26.6	26.8		27.0	27.6	27.4	27.6	27.4	28.0	28.0	27.4
Chlorophyll a		1.0		2.6	1.2	0.4	0.8	0.6	1.0	1.0	1.1
Calcium		43.30		40.60	40.60	40.00	39.60	40.20	40.20	41.00	40.69
Magnesium		6.880		7.080	7.160	7.160	7.240	7.320	7.140	7.320	7.163
Sodium		15.80		15.70	16.40	15.60	16.20	16.40	15.30	16.20	15.95
Potassium		1.86		1.90	1.84	1.82	1.86	1.84	1.90	2.02	1.88
Sulphate		19.0		18.5	18.5	18.5	19.0	18.5	19.0	19.5	18.8
Colour (TCU)		4.2		10.4	4.2	4.2	4.0	2.2	4.6	4.6	4.8
Conductivity (μS/cm)		343		337	335	322	330	333	336	342	335
pH		8.3		8.3	8.4	8.4	8.3	8.3	8.2	8.3	8.3
Alkalinity		117		113	110	109	106	110	110	114	111
Turbidity (FTU)		0.82		0.90	1.10	1.23	1.19	1.48	1.25	1.67	1.21
Nitrogen: ammonium	0.008	0.020		0.014	0.032	0.028	0.034	0.046	0.038	0.034	0.028
Nitrogen: nitrite	0.001	0.001		0.002	0.002	0.001	0.004	0.002	0.001	0.001	0.002
Nitrogen: nitrate+nitrite	0.010	0.005		0.030	0.010	0.005	0.015	0.025	0.020	0.025	0.016
Phosphorus: phosphate	0.001	0.001		0.003	0.004	0.001	0.002	0.004	0.001	0.001	0.002
Phosphorus: total	0.008	0.012		0.008	0.010	0.010	0.008	0.008	0.008	0.008	0.009
Nitorgen: total Kjeldahl	0.400	0.340		0.480	0.400	0.420	0.460	0.420	0.440	0.420	0.420
TN:TP (ratio)	51.3	28.8		63.8	41.0	42.5	59.4	55.6	57.5	55.6	50.6
Carbon: dissolved organic	3.7	4.1		4.2	4.3	4.2	4.2	4.1	4.2	4.2	4.1
Carbon: dissolved inorganic	26.6	27.0		25.8	25.6	24.6	25.2	25.0	24.6	25.4	25.5
Silicon: reactive silicate	0.76	0.88		1.58	1.66	1.44	1.36	1.36	1.30	1.32	1.30
Aluminium	0.005	0.007	0.008	0.006	0.006	0.009	0.006	0.008	0.007	0.007	0.007
Iron	0.009	0.008	0.003	0.004	0.005	0.006	0.004	0.009	0.006	0.007	0.006
Lead		0.002		0.003	0.002	0.004	0.007	0.006	0.005	0.001	0.004
1 MOB											
Turbidity (FTU)		1.70		1.03	1.75	1.44	1.34	1.63	2.10	1.60	1.57
Nitrogen: Ammonium	0.002	0.016		0.022	0.034	0.044	0.048	0.048	0.040	0.036	0.032
Nitrogen: Nitrite	0.001	0.002		0.001	0.005	0.001	0.004	0.002	0.001	0.002	0.002
Nitrogen: nitrate+nitrite	0.005	0.035		0.030	0.015	0.005	0.020	0.025	0.025	0.020	0.020
Total Kjeldahl	0.440	0.440		0.480	0.460	0.480	0.560	0.460	0.440	0.440	0.467
Phosphorus: phosphate	0.001	0.004		0.003	0.003	0.001	0.001	0.003	0.001	0.001	0.002
Phosphorus: Total	0.008	0.014		0.014	0.008	0.008	0.010	0.012	0.008	0.010	0.010
TN:TP (ratio)	55.6	33.9		36.4	59.4	60.6	58.0	40.4	58.1	46.0	49.8
Carbon: dissolved organic	3.8										3.8
Carbon: dissolved inorganic	26.6										26.6
Silicon: reactive silicate	0.72										0.72
Aluminium	0.005	0.011	0.008	0.009	0.006	0.008	0.007	0.009	0.010	0.007	0.008
Iron	0.010	0.008	0.004	0.005	0.007	0.006	0.006	0.007	0.010	0.006	0.007
Lead		ND		0.022	0.009	0.012	0.007	0.006	0.023	0.015	0.012

Depth (m)	June 3 Oxy.	June 3 Temp.	June 17 Oxy.	June 17 Temp.	July 8 Oxy.	July 8 Temp.	July 22 Oxy.	July 22 Temp.	August 8 Oxy.	August 8 Temp.	August 22 Oxy.	August 22 Temp.	September 10 Oxy.	September 10 Temp.	September 25 Oxy.	September 25 Temp.	October 7 Oxy.	October 7 Temp.	October 23 Oxy.	October 23 Temp.
0	7.7	14.7	9.5	19.6	8.3	20.6	8.7	22.0	9.0	21.8	8.2	19.6	9.0	18.5	10.0	15.1	10.2	15.4	9.9	9.9
2	7.0	14.6	9.4	19.6	8.3	20.6	8.4	22.0	9.5	21.8	8.2	19.6	9.0	18.5	9.8	15.1	10.4	15.0	9.9	9.9
4	6.5	14.5	9.4	19.5	8.3	20.6	8.8	22.0	10.0	21.8	8.2	19.6	9.0	18.5	9.8	15.1	10.4	14.9	9.9	9.9
6	6.2	14.4	9.8	19.0	8.3	20.6	8.9	21.9	10.5	21.8	8.2	19.6	8.9	18.5	9.8	15.1	10.4	14.1	9.9	9.9
8	6.3	12.3	9.8	16.1	8.2	20.6	9.0	20.1	10.5	21.8	8.2	19.6	8.8	18.5	9.8	15.1	10.2	14.1	9.9	9.9

Legend

Note: All measurements in mg/L unless otherwise indicated.
TN: Total Nitrogen = Nitrates + Nitrites + Kjeldahl
TP: Total Phosphorus
Euphotic Zone: 2x secchi depth
Oxy.: Oxygen (mg/L)

1 MOB = 1 metre off bottom
ND: non-detect
Temp.: Temperature (°C)

Table 1. Water chemistry data representative of the general water quality of Lake Couchiching, 1997.

STATION 5	June 3		June 17		July 8		July 22		August 8		August 22		September 10		September 25		October 7		October 23		Mean
Euphotic Zone																					
Secchi disc depth (m)	5.5		7.0		5.5		6.1		4.5		4.0		4.0		4.0		6.3		4.5		5.1
Chloride	26.6		26.8				27.0		27.6		27.4		27.6		27.4		28.0		28.0		27.4
Chlorophyll a			1.0				2.6		1.2		0.4		0.8		0.6		1.0		1.0		1.1
Calcium			43.30				40.60		40.60		40.00		39.60		40.20		40.20		41.00		40.69
Magnesium			6.880				7.080		7.160		7.160		7.240		7.320		7.140		7.320		7.163
Sodium			15.80				15.70		16.40		15.60		16.20		16.40		15.30		16.20		15.95
Potassium			1.86				1.90		1.84		1.82		1.86		1.84		1.90		2.02		1.88
Sulphate			19.0				18.5		18.5		18.5		19.0		18.5		19.0		19.5		18.8
Colour (TCU)			4.2				10.4		4.2		4.2		4.0		2.2		4.6		4.6		4.8
Conductivity (µS/cm)			343				337		335		322		330		333		336		342		335
pH			8.3				8.3		8.4		8.4		8.3		8.3		8.2		8.3		8.3
Alkalinity			117				113		110		109		106		110		110		114		111
Turbidity (FTU)			0.82				0.90		1.10		1.23		1.19		1.48		1.25		1.67		1.21
Nitrogen: ammonium	0.008		0.020				0.014		0.032		0.028		0.034		0.046		0.038		0.034		0.028
Nitrogen: nitrite	0.001		0.001				0.002		0.002		0.001		0.004		0.002		0.001		0.001		0.002
Nitrogen: nitrate+nitrite	0.010		0.005				0.030		0.010		0.005		0.015		0.025		0.020		0.025		0.016
Phosphorus: phosphate	0.001		0.001				0.003		0.004		0.001		0.002		0.004		0.001		0.001		0.002
Phosphorus: total	0.008		0.012				0.008		0.010		0.010		0.008		0.008		0.008		0.008		0.009
Nitorgen: total Kjeldahl	0.400		0.340				0.480		0.400		0.420		0.460		0.420		0.440		0.420		0.420
TN:TP (ratio)	51.3		28.8				63.8		41.0		42.5		59.4		55.6		57.5		55.6		50.6
Carbon: dissolved organic	3.7		4.1				4.2		4.3		4.2		4.2		4.1		4.2		4.2		4.1
Carbon: dissolved inorganic	26.6		27.0				25.8		25.6		24.6		25.2		25.0		24.6		25.4		25.5
Silicon: reactive silicate	0.76		0.88				1.58		1.66		1.44		1.36		1.36		1.30		1.32		1.30
Aluminium	0.005		0.007		0.008		0.006		0.006		0.009		0.006		0.008		0.007		0.007		0.007
Iron	0.009		0.008		0.003		0.004		0.005		0.006		0.004		0.009		0.006		0.007		0.006
Lead			0.002				0.003		0.002		0.004		0.007		0.006		0.005		0.001		0.004
1 MOB																					
Turbidity (FTU)			1.70				1.03		1.75		1.44		1.34		1.63		2.10		1.60		1.57
Nitrogen: Ammonium	0.002		0.016				0.022		0.034		0.044		0.048		0.048		0.040		0.036		0.032
Nitrogen: Nitrite	0.001		0.002				0.001		0.005		0.001		0.004		0.002		0.001		0.002		0.002
Nitrogen: nitrate+nitrite	0.005		0.035				0.030		0.015		0.005		0.020		0.025		0.025		0.020		0.020
Total Kjeldahl	0.440		0.440				0.480		0.460		0.480		0.560		0.460		0.440		0.440		0.467
Phosphorus: phosphate	0.001		0.004				0.003		0.003		0.001		0.001		0.003		0.001		0.001		0.002
Phosphorus: Total	0.008		0.014				0.014		0.008		0.008		0.010		0.012		0.008		0.010		0.010
TN:TP (ratio)	55.6		33.9				36.4		59.4		60.6		58.0		40.4		58.1		46.0		49.8
Carbon: dissolved organic	3.8																				3.8
Carbon: dissolved inorganic	26.6																				26.6
Silicon: reactive silicate	0.72																				0.72
Aluminium	0.005		0.011		0.008		0.009		0.006		0.008		0.007		0.009		0.010		0.007		0.008
Iron	0.010		0.008		0.004		0.005		0.007		0.006		0.006		0.007		0.010		0.006		0.007
Lead			ND				0.022		0.009		0.012		0.007		0.006		0.023		0.015		0.012
	Oxy.	Temp.	Oxy.	Temp.	Oxy.	Temp.	Oxy.	Temp.	Oxy.	Temp.	Oxy.	Temp.	Oxy.	Temp.	Oxy.	Temp.	Oxy.	Temp.	Oxy.	Temp.	
Depth (m)																					
0	7.7	14.7	9.5	19.6	8.3	20.6	8.7	22.0	9.0	21.8	8.2	19.6	9.0	18.5	10.0	15.1	10.2	15.4	9.9	9.9	
2	7.0	14.6	9.4	19.6	8.3	20.6	8.4	22.0	9.5	21.8	8.2	19.6	9.0	18.5	9.8	15.1	10.4	15.0	9.9	9.9	
4	6.5	14.5	9.4	19.5	8.3	20.6	8.8	22.0	10.0	21.8	8.2	19.6	9.0	18.5	9.8	15.1	10.4	14.9	9.9	9.9	
6	6.2	14.4	9.8	19.0	8.3	20.6	8.9	21.9	10.5	21.8	8.2	19.6	8.9	18.5	9.8	15.1	10.4	14.1	9.9	9.9	
8	6.3	12.3	9.8	16.1	8.2	20.6	9.0	20.1	10.5	21.8	8.2	19.6	8.8	18.5	9.8	15.1	10.2	14.1	9.9	9.9	

Legend

Note: All measurements in mg/L unless otherwise indicated.
TN: Total Nitrogen = Nitrates + Nitrites + Kjeldahl
TP: Total Phosphorus
Euphotic Zone: 2x secchi depth
Oxy.: Oxygen (mg/L)

1 MOB = 1 metre off bottom
ND: non-detect
Temp.: Temperature (°C)

Table 1 (cont'd). Water quality of Stations 12, 15 and 21. Lake Couchiching, 1997.

STATION 12 Euphotic Zone	June 3	June 17	July 8	July 22	August 8	August 22	September 10	September 25	October 7	October 23	Mean
Chloride	26.8	27.2		27.2	27.8	27.6	28.0	27.6	27.6	28.0	27.5
Chlorophyll a		0.6		1.6	0.6	0.4	0.8	0.6	0.8	0.4	0.7
Calcium					36.20		37.50				36.85
Magnesium					7.200		7.300				7.250
Sodium					16.90		16.20				16.55
Potassium					1.95		1.92				1.94
Sulphate					18.0		19.0				18.5
Colour (TCU)					5.0		3.8				4.4
Conductivity (µS/cm)					320		324				322
pH					8.4		8.2				8.3
Alkalinity					101		102				102
Turbidity (FTU)		1.08		1.67	4.10	2.10	1.55	2.70	2.50	1.48	2.15
Nitrogen: ammonium	0.010	0.018		0.016	0.032	0.016	0.024	0.034	0.032	0.032	0.024
Nitrogen: nitrite	0.001	0.001		0.001	0.002	0.001	0.003	0.001	0.002	0.002	0.002
Nirogen: nitrate+nitrite	0.005	0.005		0.025	0.005	0.005	0.020	0.020	0.015	0.020	0.013
Nitrogen: total Kjeldahl	0.360	0.360		0.480	0.500	0.420	0.460	0.440	0.340	0.440	0.422
Phosphorus: phosphate	0.001	0.001		0.003	0.003	0.001	0.001	0.003	0.001	0.001	0.001
Phosphorus, total	0.006	0.006		0.008	0.014	0.010	0.006	0.006	0.006	0.006	0.008
TN:TP (ratio)	60.8	60.8		63.1	36.1	42.5	80.0	76.7	59.2	76.7	61.8
Carbon: dissolved organic	3.9				4.6		4.3				4.3
Carbon: dissolved inorganic	25.2				22.8		24.0				24.0
Silicon: reactive silicate	0.44				1.74		1.50				1.23
Aluminium	0.006										0.006
Iron	0.007										0.007
Lead											
STATION 15											
Euphotic Zone											
Chloride	26.8	27.0	26.8	27.2	27.4	27.6	27.8	27.6	28.0	27.8	27.4
Chlorophyll a		1.0	1.6	2.6	1.6	0.6	1.0	0.8	1.4	0.8	1.3
Calcium			40.30		39.90		38.50				39.57
Magnesium			6.960		7.120		7.240				7.107
Sodium			15.90		16.50		16.10				16.17
Potassium			1.94		1.86		1.88				1.89
Sulphate			16.5		18.0		19.0				17.8
Colour (TCU)			3.8		4.6		3.8				4.1
Conductivity (µS/cm)			335		333		326				331
pH			8.3		8.4		8.2				8.3
Alkalinity					111		104				108
Turbidity (FTU)		0.88		1.01	0.96	2.30	1.46	1.84	1.35	1.24	1.38
Nitrogen: Ammonium	0.008	0.012		0.010	0.032	0.010	0.032	0.038	0.030	0.038	0.023
Nitrogen: Nitrite	0.001	0.001		0.001	0.002	0.001	0.003	0.002	0.001	0.002	0.002
Nitrogen: nitrate+nitrite	0.005	0.005		0.025	0.005	0.005	0.025	0.020	0.025	0.025	0.016
Nitrogen: total Kjeldahl	0.360	0.360		0.440	0.420	0.420	0.440	0.420	0.440	0.440	0.416
Phosphorus: phosphate	0.001	0.001		0.003	0.003	0.004	0.001	0.002	0.001	0.001	0.002
Phosphorus: total	0.006	0.008		0.010	0.006	0.010	0.008	0.014	0.008	0.006	0.008
TN:TP (ratio)	60.8	45.6		46.5	70.8	42.5	58.1	31.4	58.1	77.5	54.6
Carbon: dissolved organic	3.8				4.3		4.2				4.1
Carbon: dissolved inorganic	25.8				24.8		24.4				25.0
Silicon: reactive silicate	0.50				1.54		1.40				1.15
Aluminium	0.006										0.006
Iron	0.002										0.002
Lead											
STATION 21											
Euphotic Zone											
Chloride		26.8	26.6	27.2	28.0	27.6	27.8	27.8	27.6	27.8	27.5
Chlorophyll a		0.6	0.8	1.6	1.0	0.6	1.0	0.6	0.8	0.6	0.8
Calcium			40.60		36.70		38.60				38.63
Magnesium			6.960		7.240		7.260				7.153
Sodium			17.30		16.70		16.20				16.73
Potassium			1.86		1.85		1.89				1.87
Sulphate			16.0		18.5		19.0				17.8
Colour (TCU)			3.8		4.8		3.8				4.1
Conductivity (µS/cm)			335		330		327				331
pH			8.3		8.4		8.2				8.3
Alkalinity					107		105				106
Turbidity (FTU)		0.66		0.86	0.75	0.90	1.49	1.39	1.10	1.21	1.05
Nitrogen: ammonium		0.018		0.016	0.032	0.024	0.026	0.038	0.030	0.032	0.027
Nitrogen: nitrite		0.001		0.001	0.006	0.001	0.004	0.002	0.001	0.002	0.002
Nitrogen: nitrate+nitrite		0.005		0.025	0.010	0.005	0.015	0.020	0.020	0.020	0.015
Nitrogen: total Kjeldahl		0.340		0.460	0.480	0.400	0.460	0.420	0.480	0.420	0.433
Phosphorus: phosphate		0.001		0.003	0.002	0.001	0.001	0.002	0.001	0.001	0.001
Phosphorus: total		0.008		0.008	0.006	0.006	0.008	0.008	0.008	0.006	0.007
TN:TP (ratio)		43.1		60.6	81.7	67.5	59.4	55.0	62.5	73.3	62.9
Carbon: dissolved organic					4.4		4.2				4.3
Carbon: dissolved inorganic					24.8		24.2				24.5
Silicon: reactive silicate					1.56		1.38				1.47
Aluminium											
Iron											
Lead											

Table 1 (cont'd). Water quality of Stations 12, 15 and 21, Lake Couchiching, 1997.

STATION 12	June 3	June 17	July 8	July 22	August 8	August 22	September 10	September 23	October 7	October 23	Mean
Euphotic Zone											
Chloride	26.8	27.2		27.2	27.8	27.6	28.0	27.6	27.6	28.0	27.5
Chlorophyll a		0.6		1.6	0.6	0.4	0.8	0.6	0.8	0.4	0.7
Calcium					36.20		37.50				36.85
Magnesium					7.200		7.300				7.250
Sodium					16.90		16.20				16.55
Potassium					1.95		1.92				1.94
Sulphate					18.0		19.0				18.5
Colour (TCU)					5.0		3.8				4.4
Conductivity (µS/cm)					320		324				322
pH					8.4		8.2				8.3
Alkalinity					101		102				102
Turbidity (FTU)		1.08		1.67	4.10	2.10	1.55	2.70	2.50	1.48	2.15
Nitrogen: ammonium	0.010	0.018		0.016	0.032	0.016	0.024	0.034	0.032	0.032	0.024
Nitrogen: nitrite	0.001	0.001		0.001	0.002	0.001	0.003	0.001	0.002	0.002	0.002
Nitrogen: nitrate+nitrite	0.005	0.005		0.025	0.005	0.005	0.020	0.020	0.015	0.020	0.013
Nitrogen: total Kjeldahl	0.360	0.360		0.480	0.500	0.420	0.460	0.440	0.340	0.440	0.422
Phosphorus: phosphate	0.001	0.001		0.003	0.003	0.001	0.001	0.003	0.001	0.001	0.001
Phosphorus, total	0.006	0.006		0.008	0.014	0.010	0.006	0.006	0.006	0.006	0.008
TN:TP (ratio)	60.8	60.8		63.1	36.1	42.5	80.0	76.7	59.2	76.7	61.8
Carbon: dissolved organic	3.9				4.6		4.3				4.3
Carbon: dissolved inorganic	25.2				22.8		24.0				24.0
Silicon: reactive silicate	0.44				1.74		1.50				1.23
Aluminium	0.006										0.006
Iron	0.007										0.007
Lead											
STATION 15											
Euphotic Zone											
Chloride	26.8	27.0	26.8	27.2	27.4	27.6	27.8	27.6	28.0	27.8	27.4
Chlorophyll a		1.0	1.6	2.6	1.6	0.6	1.0	0.8	1.4	0.8	1.3
Calcium			40.30		39.90		38.50				39.57
Magnesium			6.960		7.120		7.240				7.107
Sodium			15.90		16.50		16.10				16.17
Potassium			1.94		1.86		1.88				1.89
Sulphate			16.5		18.0		19.0				17.8
Colour (TCU)			3.8		4.6		3.8				4.1
Conductivity (µS/cm)			335		333		326				331
pH			8.3		8.4		8.2				8.3
Alkalinity					111		104				108
Turbidity (FTU)		0.88		1.01	0.96	2.30	1.46	1.84	1.35	1.24	1.38
Nitrogen: Ammonium	0.008	0.012		0.010	0.032	0.010	0.032	0.038	0.030	0.038	0.023
Nitrogen: Nitrite	0.001	0.001		0.001	0.002	0.001	0.003	0.002	0.001	0.002	0.002
Nitrogen: nitrate+nitrite	0.005	0.005		0.025	0.005	0.005	0.025	0.020	0.025	0.025	0.016
Nitrogen: total Kjeldahl	0.360	0.360		0.440	0.420	0.420	0.440	0.420	0.440	0.440	0.416
Phosphorus: phosphate	0.001	0.001		0.003	0.003	0.004	0.001	0.002	0.001	0.001	0.002
Phosphorus: total	0.006	0.008		0.010	0.006	0.010	0.008	0.014	0.008	0.006	0.008
TN:TP (ratio)	60.8	45.6		46.5	70.8	42.5	58.1	31.4	58.1	77.5	54.6
Carbon: dissolved organic	3.8				4.3		4.2				4.1
Carbon: dissolved inorganic	25.8				24.8		24.4				25.0
Silicon: reactive silicate	0.50				1.54		1.40				1.15
Aluminium	0.006										0.006
Iron	0.002										0.002
Lead											
STATION 21											
Euphotic Zone											
Chloride		26.8	26.6	27.2	28.0	27.6	27.8	27.8	27.6	27.8	27.5
Chlorophyll a		0.6	0.8	1.6	1.0	0.6	1.0	0.6	0.8	0.6	0.8
Calcium			40.60		36.70		38.60				38.63
Magnesium			6.960		7.240		7.260				7.153
Sodium			17.30		16.70		16.20				16.73
Potassium			1.86		1.85		1.89				1.87
Sulphate			16.0		18.5		19.0				17.8
Colour (TCU)			3.8		4.8		3.8				4.1
Conductivity (µS/cm)			335		330		327				331
pH			8.3		8.4		8.2				8.3
Alkalinity					107		105				106
Turbidity (FTU)		0.66		0.86	0.75	0.90	1.49	1.39	1.10	1.21	1.05
Nitrogen: ammonium		0.018		0.016	0.032	0.024	0.026	0.038	0.030	0.032	0.027
Nitrogen: nitrite		0.001		0.001	0.006	0.001	0.004	0.002	0.001	0.002	0.002
Nitrogen: nitrate+nitrite		0.005		0.025	0.010	0.005	0.015	0.020	0.020	0.020	0.015
Nitrogen: total Kjeldahl		0.340		0.460	0.480	0.400	0.460	0.420	0.480	0.420	0.433
Phosphorus: phosphate		0.001		0.003	0.002	0.001	0.001	0.002	0.001	0.001	0.001
Phosphorus: total		0.008		0.008	0.006	0.006	0.008	0.008	0.008	0.006	0.007
TN:TP (ratio)		43.1		60.6	81.7	67.5	59.4	55.0	62.5	73.3	62.9
Carbon: dissolved organic					4.4		4.2				4.3
Carbon: dissolved inorganic					24.8		24.2				24.5
Silicon: reactive silicate					1.56		1.38				1.47
Aluminium											
Iron											
Lead											

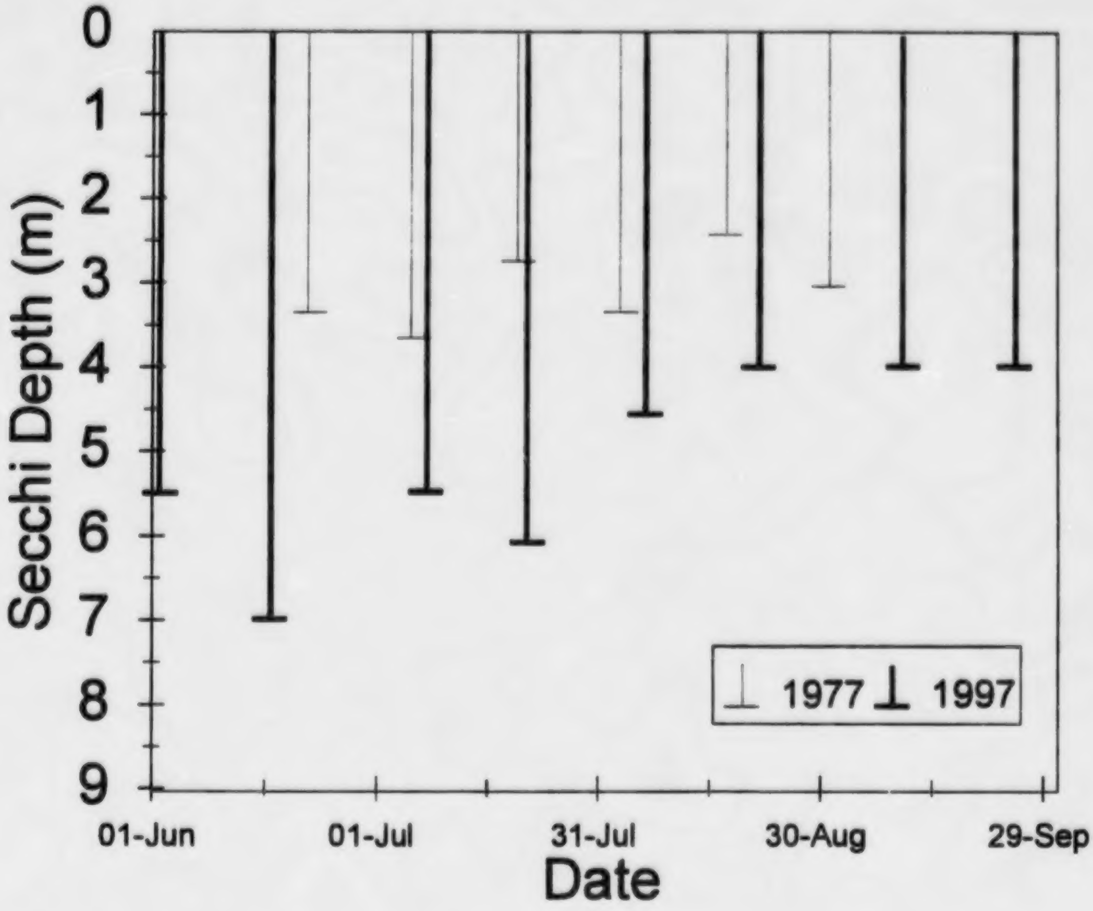

Figure 4. Seasonal variations in Secchi disc depths (m) in 1977 and 1997.

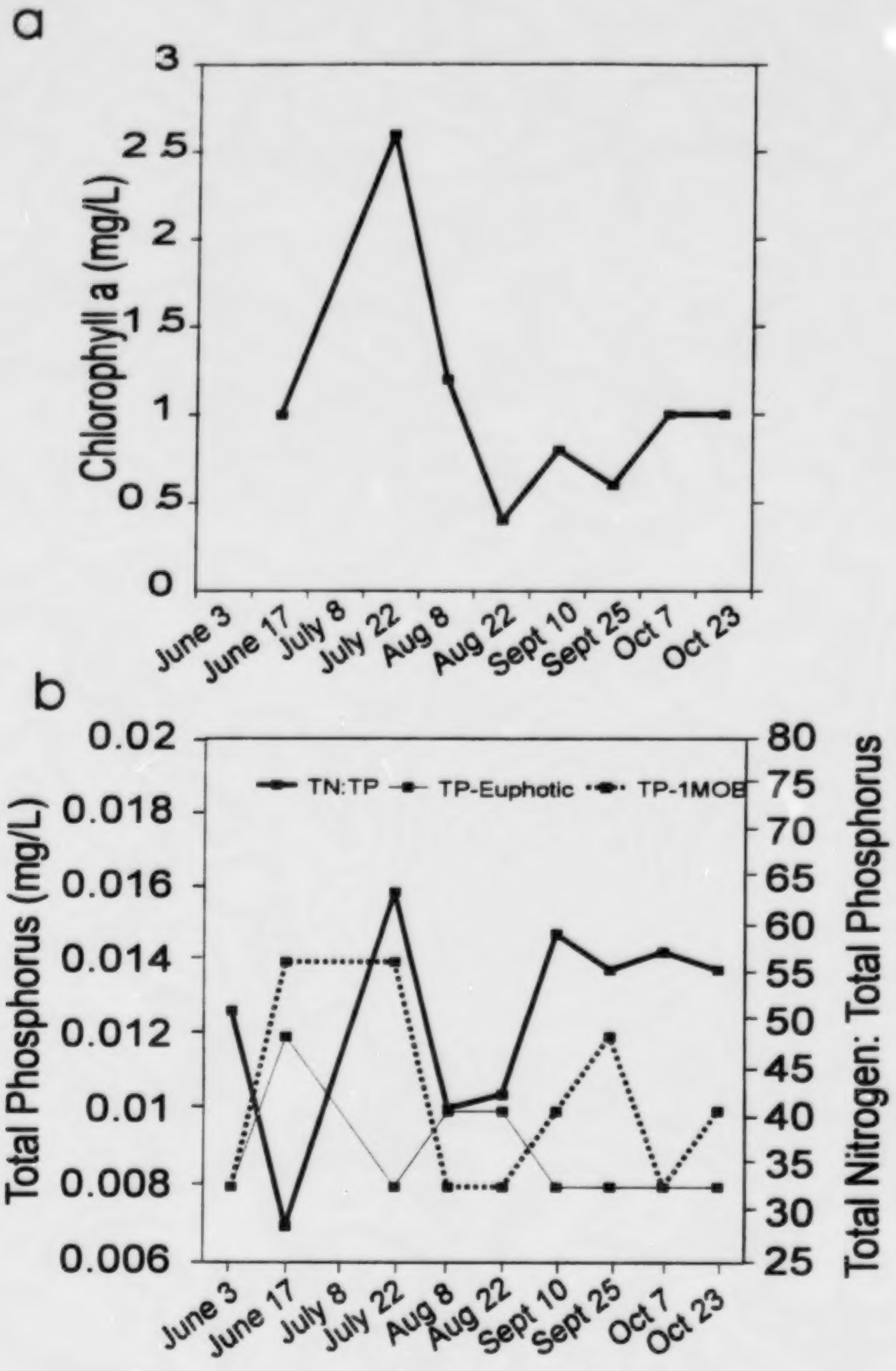

Figure 5. **Seasonal variations in concentrations of chlorophyll *a* (a), and total phosphorus and TN:TP ratio (b) at Station 5 in Lake Couchiching during 1997.**

Where phosphorus is limiting, the OMOEE (1994b) recommends that total phosphorus concentrations be kept below 0.020 mg/L to avoid nuisance growths of algae. The Ministry also recommends that total phosphorus be kept below 0.010 mg/L to provide a high level of protection against aesthetic degradation. Among the nearshore stations, total phosphorus concentrations ranged between 0.006 and 0.016 mg/L (Figure 6, Appendix D), with concentrations in excess of 0.010 mg/L at all stations during at least one survey with the exception of Stations 11, 19 and 20 (Appendix D). There were no spatial patterns in total phosphorus concentrations that indicated important point sources of pollution.

Phosphorus concentrations at the four mid-lake stations were similar to concentrations at the nearshore stations. Mid-lake annual average total phosphorus concentrations (TP) ranged from 0.007 to 0.009 mg/L (Figure 5, Table 1). Spring concentrations were slightly higher at Station 5, trending downwards as the season progressed. A short-lived TP peak of 0.012 mg/L was detected on June 17 (Figure 5). Total phosphorus concentrations were slightly higher near the bottom with an annual average of 0.010 mg/L and a mid-summer maximum of 0.014 mg/L at Station 12 (Table 1). Variations in euphotic zone and 1 MOB phosphorus concentrations were probably associated with bioturbation (Redshaw et al., 1990), temperatures variations and resuspension of sediments through wind action (Quigley and Robbins, 1986).

The high pH of waters and the presence of carbonate deposits on *Chara* and in the sediments suggest that Lake Couchiching has at least some of the characteristics of a marl lake. In such lakes, primary production is phosphorus-limited, partly because phosphorus is precipitated out of the water column into the sediments, as iron and manganese complexes (Wetzel, 1983).

Silica

Silica concentrations varied between 0.34 and 1.56 mg/L among the nearshore stations (Appendix D). Among the four mid-lake stations (5, 12, 15, 21), silica concentrations were lowest in spring, rising through the early summer to peak levels in late July (1.66 mg/L). Levels fell through August before stabilizing in September and October (Table 1). Rising silica concentrations during June and July preceded the onset of the diatom bloom which dominated the phytoplankton community most of the year (Section 4.4.1). Diatoms utilize silica in the construction of their frustules, so the decline in silica levels documented during the diatom bloom was typical (Klemer and Barko, 1991).

Chlorophyll **a**

In early June, chlorophyll *a* concentrations were lowest in the southern two-thirds of the lake (0.09 - 0.14 μg/L), with patches of higher concentrations (0.14-0.19 μg/L) southeast of Chiefs Island and in the northern half of the lake. The highest concentrations (0.19 to 0.24 μg/L) were found along the nearshore between Quarry Bay and Floral Point. Among the nearshore stations, values ranged from trace amounts to 2.6 μg/L in June, and from trace to 1.6 μg/L in July among the nearshore stations. Among the mid-lake stations, chlorophyll *a* concentrations ranged from 0.5 to 2.6 μg/L (Figure 5). At all four mid-lake stations, chlorophyll *a* concentrations peaked in mid-July and were at their lowest through late August and September. Based on the observed chlorophyll *a* concentrations, Lake Couchiching can be classified as oligotrophic to slightly mesotrophic. Carleton (1977) classified lakes with summer average chlorophyll *a* concentrations of between 1 and 6.4 μg/L as mesotrophic.

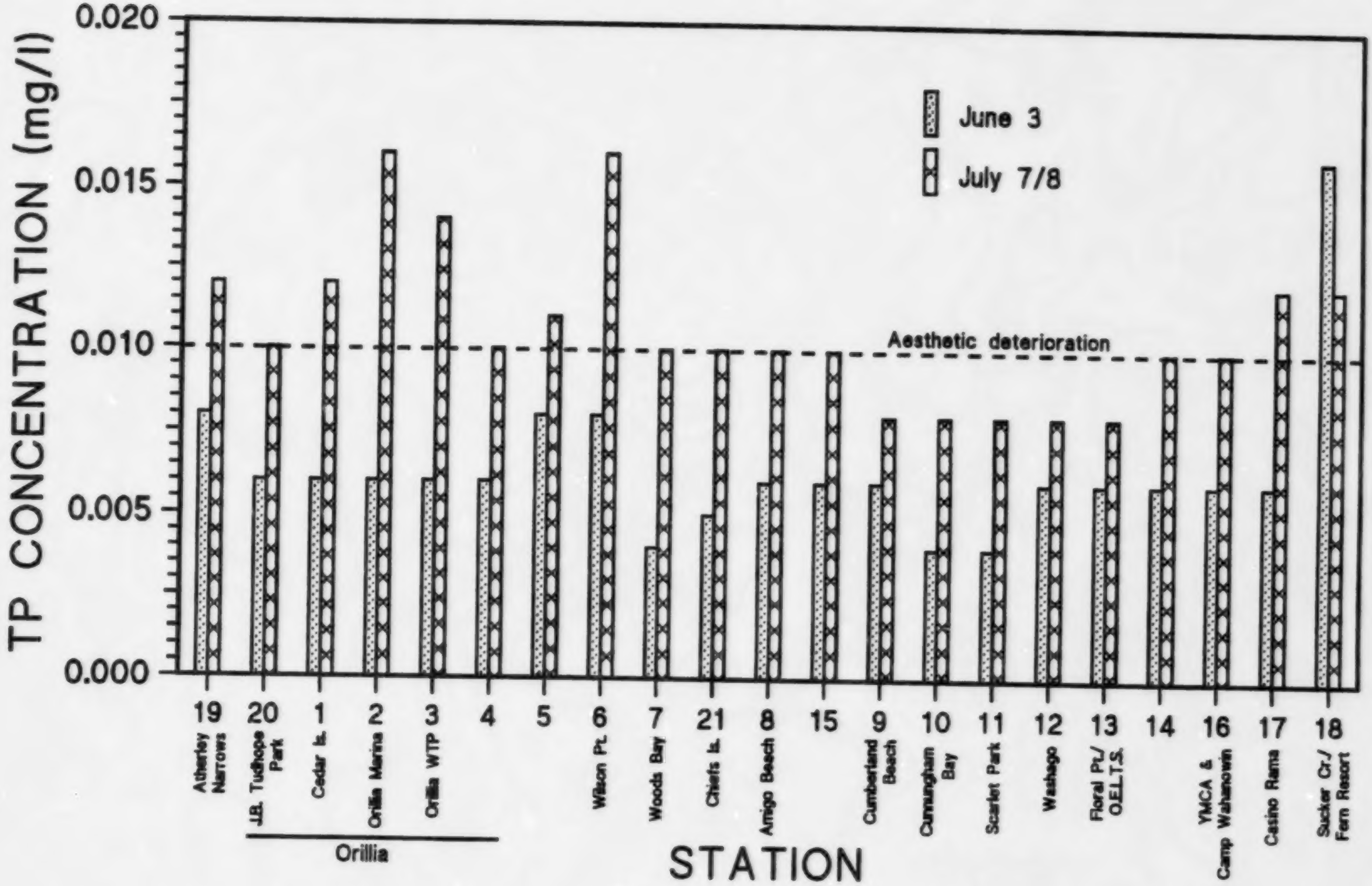

Figure 6. Spatial variations in total phosphorus concentrations in Lake Couchiching on June 3 and July 7/8.

4.2.5 Bacteria
Bacteria were detected infrequently and at low densities in Lake Couchiching. The highest density or concentration of the indicator *Escherichia coli*, 36 organisms per 100 ml at Station 1 near Cedar Island, was well below the PWQO (OMOEE, 1994b) of 100 organisms per 100 ml for the protection of recreational water users. These data are consistent with historical findings (Katona, 1998). Faecal *Streptococcus* was detected at a maximum density of 18 organisms per 100 ml, again at Station 1 near Cedar Point. There is currently no limit for the numbers of faecal streptococci (CCME, 1991). The pathogen *Pseudomonas aeruginosa* was not detected in any of the samples (Appendix D). Based on these data for faecal coliforms, there is no apparent risk of infection by swimming in Lake Couchiching.

4.2.6 Taste and Odour Problems
Residents of Orillia have complained about poor taste and odour of municipal water supplies originating from Lake Couchiching. Taste and odour problems have been attributed to two compounds (geosmin, or 1,10-trans-dimethyl-trans-9-decalol, and 2-MIB or 2-methylisoborneol) that originate primarily in algae (Katona, 1998). Previous work has shown that algal densities in the water column of Lake Couchiching are below thresholds that would cause taste and odour problems (Katona, 1998). It has been suggested, however, that green and blue-green algae that reside on the bottom of the lake may be responsible for the poor taste and adour. Indirectly, the introduction of zebra mussels to the lake may be responsible for the poor taste and odour. Where zebra mussels colonize, densities of benthic algae have been shown to increase (Lowe and Pillsbury, 1995). Zebra mussels have colonized virtually every location within the lake and this survey did document obvious growths of benthic algae (Section 4.4).

4.2.7 Metals
Metal levels in Lake Couchiching water were very low and averaged from one (e.g., cadmium) to four orders of magnitude (e.g., beryllium) lower than their respective Provincial Water Quality Objectives (PWQOs) (Appendix D). Only one duplicate sample of mercury from Station 21 in June (0.25 μg/L) slightly exceeded the PWQO of 0.2 μg/L.

4.2.8 Organic Contaminants
Of the 30 organic compounds for which water samples were screened, only atrazine was found at 'trace' levels of 66 to 140 ng/L, in 15 of the 24 samples collected (Appendix D). No phenoxy acid herbicides or chlorophenols were detected in Lake Couchiching water. Atrazine was detected at "trace" amounts (i.e., less than 150 mg/L in over half of the water samples, with most of the detections occurring along the western shore where temperatures were warmer. Atrazine has a short half life and probably originates from agricultural runoff. Surface runoff from agricultural landscapes should be warmer than typical stream runoff. Both higher temperatures and trace amounts of atrazine therefore suggest that runoff from agricultural areas are being introduced to the lake along the western shore. Concentrations of atrazine were below levels that pose ecological or human health risks. The federal water quality guideline for the protection of aquatic life is set at1800 ng/L, while the federal drinking water objective is set at 5000 ng/L (CCME, 1991).

4.3 Sediment Characteristics and Quality

Sediment chemistry data from this study (Appendices E, F) were compared to the Provincial Sediment Quality Guidelines (PSQG; Persaud *et al.*, 1993) as well as to data from deeper layers of the cores obtained from Stations 5 and 15, which should represent background levels for the inorganic contaminants in this system.

4.3.1 Core Sediments from Stations 5 and 15

Visual, olfactory and chemical characteristics of the surface (0-5 cm) sections from cores collected at stations in the middle and southern basin of the lake were generally consistent with the information obtained from the surficial sediment samples. Surface layers at Stations 5 and 15 consisted of a gray or gray-brown, watery ooze (Appendix F). At Station 5, where an odour of rotten eggs was given off by the surface sediment, this odour persisted to a depth of 35-45 cm. At ~95 cm depth a gray clay or clay-like material appeared. Moisture content of the sediments decreased from 74-75 % in the surface (0-5 cm) layers, to 47-51 % at depths of a metre or more, probably due to compaction. Below 15 cm depth, white particles of marl (calcium carbonate) were evident, and snail or clam shells or fragments were also found in some sediment layers. Microscopic and size distribution analysis by sieving indicated that medium to fine sand, and silt and clay predominated in the sediments, with fine particles of less than 63-μm diameter (silt and clay) usually contributing 50 % or more of the sediment.

Calcium, magnesium, aluminum, barium, cobalt, iron, manganese and strontium concentrations were relatively constant with depth, whereas titanium increased slightly in deeper sediment. In contrast, concentrations of chloride, cadmium, copper, lead, zinc and mercury increased markedly in more recently deposited (upper 15-25 cm) sediments (Figures 7, 8). The core sections were not dated for this study, so no age in terms of years can be assigned to the different layers of the cores. Nevertheless, increased levels of chloride in surface sediments probably reflect urban development and increasing use of road salt. Similar increasing trends in chloride levels in water from Lake Simcoe have been shown (LSRCA et al., 1995). An increase in lead levels in surficial sediments is a typical result because of the historic use of leaded gasoline. Cadmium, copper, lead and zinc can also be contributed from urban areas (Klassen, 1992; Schueler, 1992). In neighbouring Lake Simcoe, mercury contamination originates from sanitary landfill sites, sewage sludge disposal areas, urban stormwater runoff, golf courses that use mercurial fungicides, and atmospheric sources. Natural geologic sources and contributions from intensive agriculture in the Holland Marsh have been shown to be insignificant (OMOE, 1978).

The average chemical concentrations in the lower sections (> 25 cm depth) of cores from Stations 5 and 15 were used as an additional comparison or reference for the concentrations found in surface (top 5 cm) sediments from stations in shallower waters of the lake.

4.3.2 Spatial Survey of Surficial (Recent) Sediments

Observations of the sediment samples indicated that the uppermost layer (surface) of sediment at most of the 21 sampling stations consisted of silty ooze. Rooted aquatic plants - particularly calcified *Chara* - were also present at all stations but 5, 15 and 17. No oil or petroleum odour was detected at any of the stations, but a number of them, particularly those situated in the southwest end of the

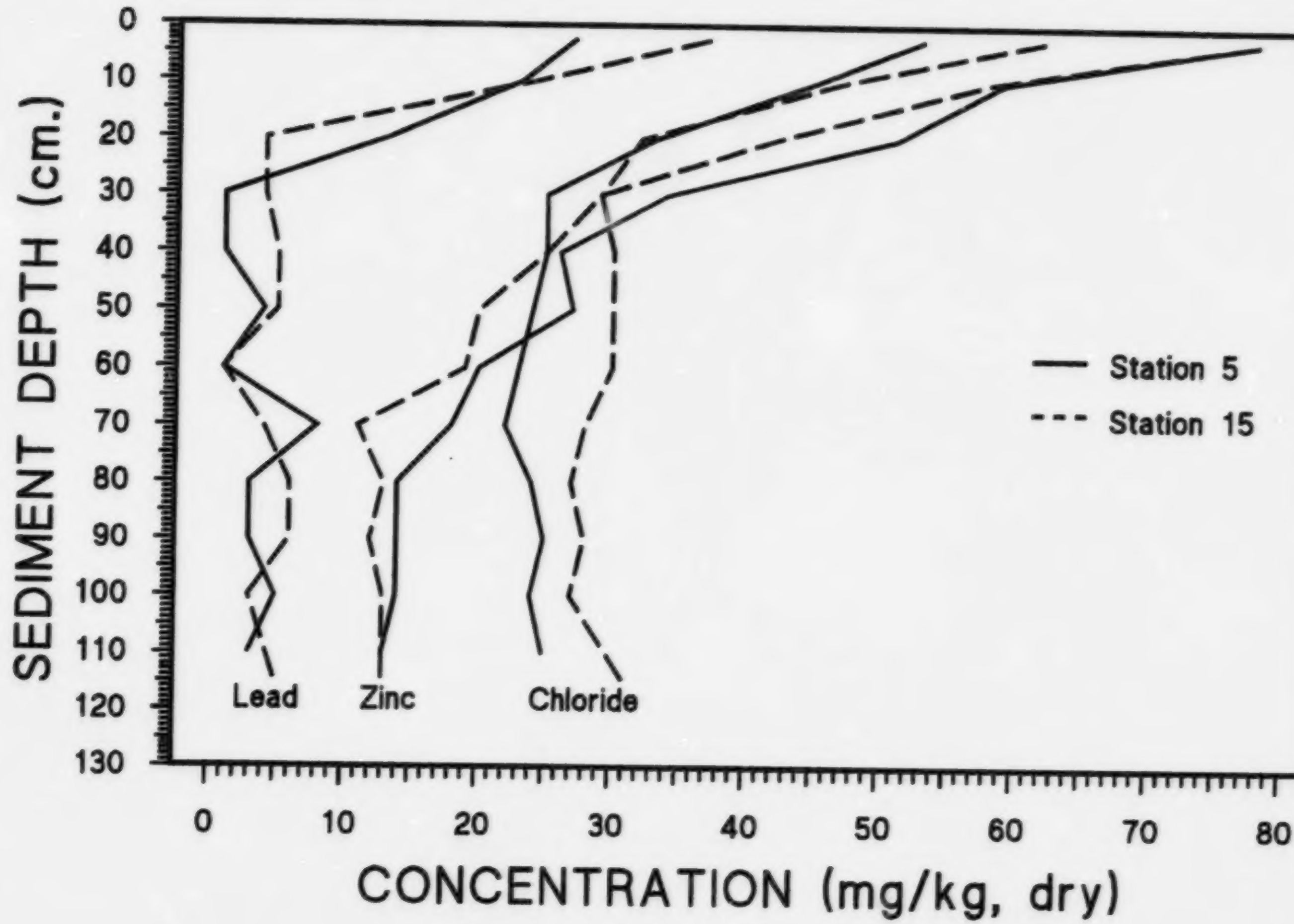

Figure 7. Concentrations of chloride, zinc and lead with increasing depth at Stations 5 and 15 in Lake Couchiching.

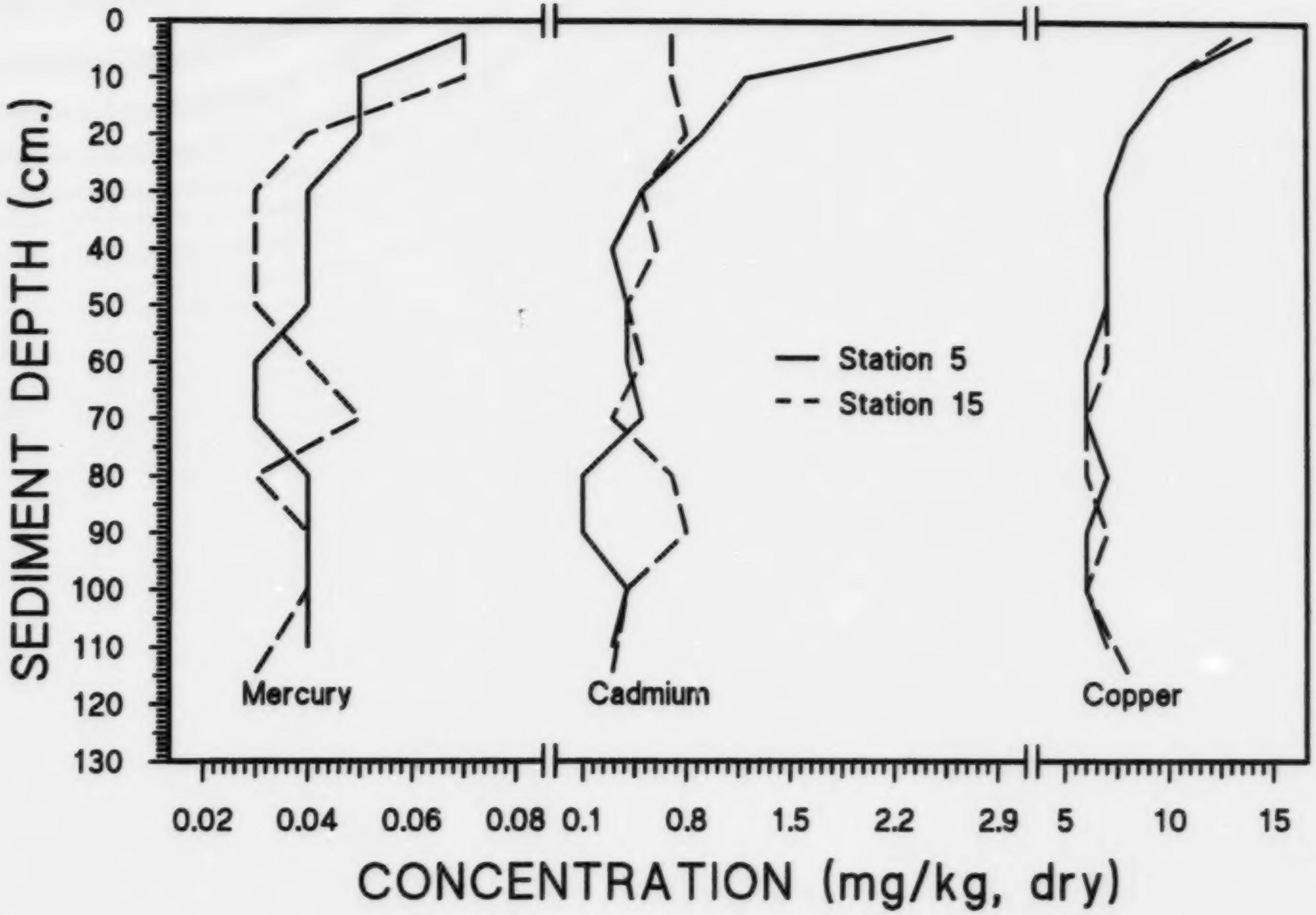

Figure 8. Concentrations of mercury, cadmium and copper with increasing depth at Stations 5 and 15 in Lake Couchiching.

lake near Orillia, had sediments which gave off a rotten egg (hydrogen sulphide) odour. Microscopic examination of these surface sediment samples showed that the majority of the sediment was composed of sand, silt and clay (carbonates and quartz), with the balance contributed by shell debris, vegetation fibres and fossilized plant material. Particle size analysis by sieving also indicated that sand, silt and clay predominated in the sediments, with fine material of less than 63-μm diameter (silt and clay) usually contributing 50 % or more of the sediment. Exceptions to this were found at Stations 10, 13, 14, and 18, where sand predominated.

The major elemental composition of a few of these samples was determined using X-ray diffraction spectroscopy. In all cases, the principal cation was calcium, followed by aluminum, iron, potassium and silica. Macro-ion and trace metals analysis of the sediment samples also indicated this trend; namely, calcium was present at the highest concentrations (77,000-210,000 mg/kg, or 7.7-21 %, by dry weight), followed by iron, aluminum, magnesium, titanium, manganese and strontium (Appendix F).

Overall, inorganic and heavy metal contaminant levels were quite low in the surface sediment samples from Lake Couchiching. The average concentrations of arsenic and selected metals for all 21 stations sampled are given below:

Element	**Average (mg/kg)**	**Element**	**Average (mg/Kg)**
arsenic	1.8	manganese	232
cadmium	0.5	mercury	0.02
chromium	11	nickel	7.6
copper	7	selenium	0.5
lead	20	zinc	35

Comparison of the surface sediment arsenic and heavy metal concentrations with the "background" concentrations derived from deeper layers of sediment cores (Section 4.3.1) revealed those locations with levels above the "background" for the lake. These stations included:

Element	**Stations above background**	**Element**	**Stations above background**
arsenic	all but 10, 13, 18	manganese	14, 17
aluminum	1, 15	molybdenum	1, 2

Element	Stations above background	Element	Stations above background
antimony	1 to 7	nickel	1, 5, 15 to 17
barium	1	selenium	1 to 5, 7, 11, 14 to 17, 19
cadmium	1, 5	strontium	2 to 5, 7, 11, 12, 16, 17, 19
chromium	1, 5, 15	titanium	1, 10, 11, 18
cobalt	1, 15	vanadium	1, 15, 18
copper	1 to 5, 15, 17	zinc	1 to 5, 14, 15, 17, 19, 20
lead	1 to 8, 11, 12, 14 to 17, 19 to 21		

Anthropogenic contamination by metals was therefore most evident at stations in the vicinity of Orillia, likely reflecting inputs such as surface runoff from urban areas (Figures 9, 10). However, with the exception of cadmium, surficial metal concentrations were all well below (by factors of up to 10) the respective PSQG Lowest Effect Level (LEL) for the protection of sediment-dwelling organisms (benthic invertebrates) (Persaud et al., 1993). LELs are the concentrations above which more than 5% of the sediment-dwelling benthic taxa can be expected to be impacted (Persaud et al., 1993). The average concentration of cadmium, 0.5 mg/kg, was only just below the PSQG-LEL of 0.6 mg/kg, due in part to high concentrations Stations 1, 3, 5, 15 and 17 (Figure 10). In addition, a few stations had concentrations of one or more of these metals above their respective guidelines. This was most evident at Station 1, just off the Orillia marina, where a variety of metals were in excess of the PSQG LEL. These included arsenic (9.5 mg/kg, LEL = 6 mg/kg), cadmium (1.9 mg/kg, LEL=0.6 mg/kg), chromium (55 mg/kg, LEL=26 mg/kg), copper (22 mg/kg, LEL=16 mg/kg), lead (58 mg/kg, LEL=31 mg/kg) and nickel (28 mg/kg, LEL=16 mg/kg) (Figures 9, 10, Appendix F). Nevertheless, these concentrations were all well below the PSQG Severe Effect Levels (SELs) for these contaminants. SELs are the concentrations above which effects can be expected on more than 95% of sediment-dwelling benthic taxa (Persaud et al., 1993).

Even though metal concentrations were low, there was evidence that at least mercury is biologically available and biomagnifies in the food chain in Lake Couchiching. Routine monitoring by the OMOEE (1997) shows that mercury levels in large specimens of smallmouth bass, largemouth bass, northern pike, walleye and yellow perch are elevated, with resultant consumption restrictions for people. In Lake Simcoe, there have been no changes in mercury concentrations in cisco, whitefish or perch since 1928.

Although nutrient concentrations increased marginally in surficial sediments relative to background concentrations, historical concentrations have generally naturally exceeded PSQGs LELs (Appendix E). For example, the LEL for total Kjeldahl nitrogen (TKN) is 0.55 g/kg. Surficial concentrations of TKN averaged 3.0 and ranged from 0.7 to 4.9 g/kg (Figure 11). However, core data show that

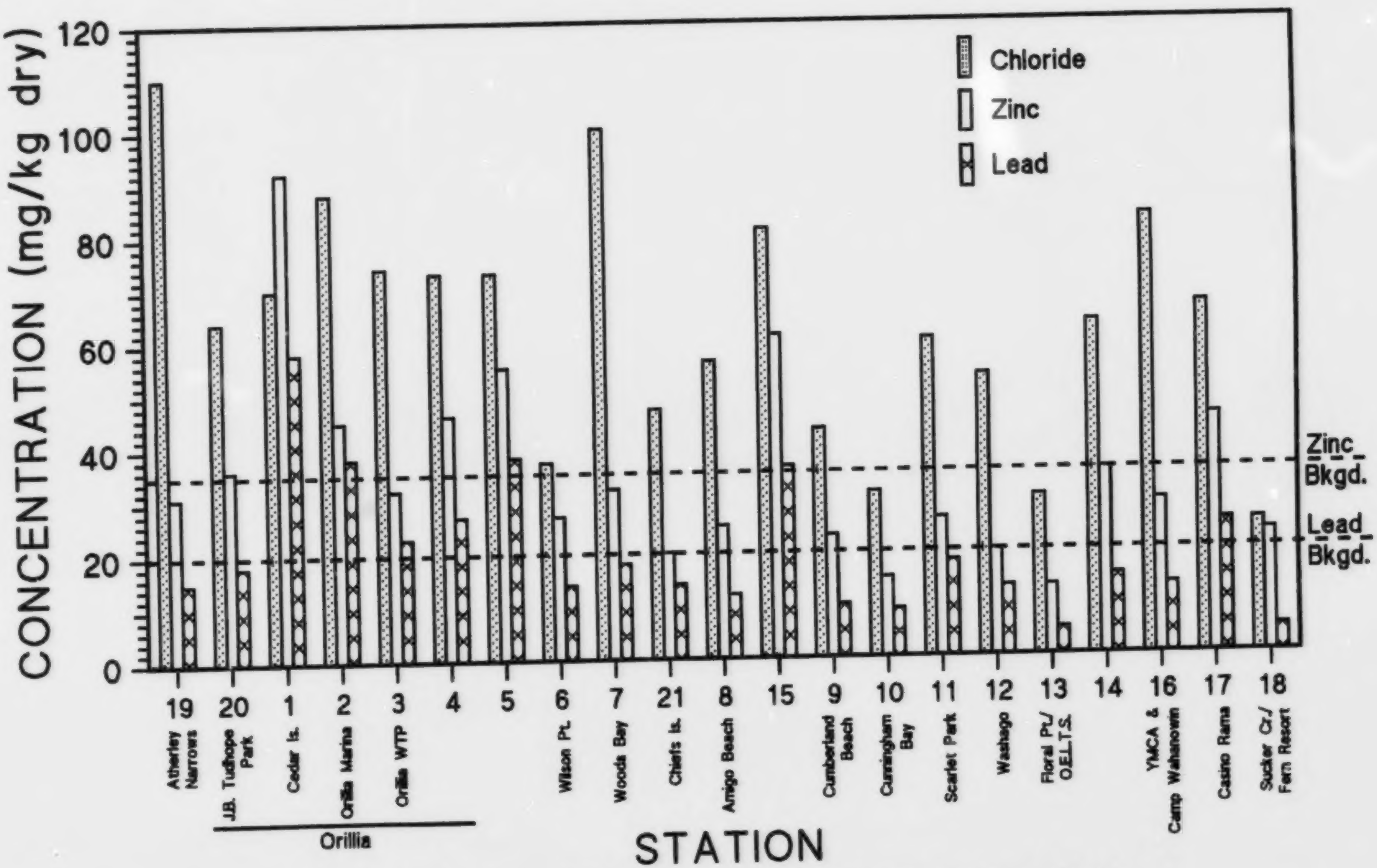

Figure 9. Spatial variations in surficial sediment concentrations of chloride, zinc and lead in Lake Couchiching. "Bkgd" = background concentrations from deep cores from Stations 5 and 15.

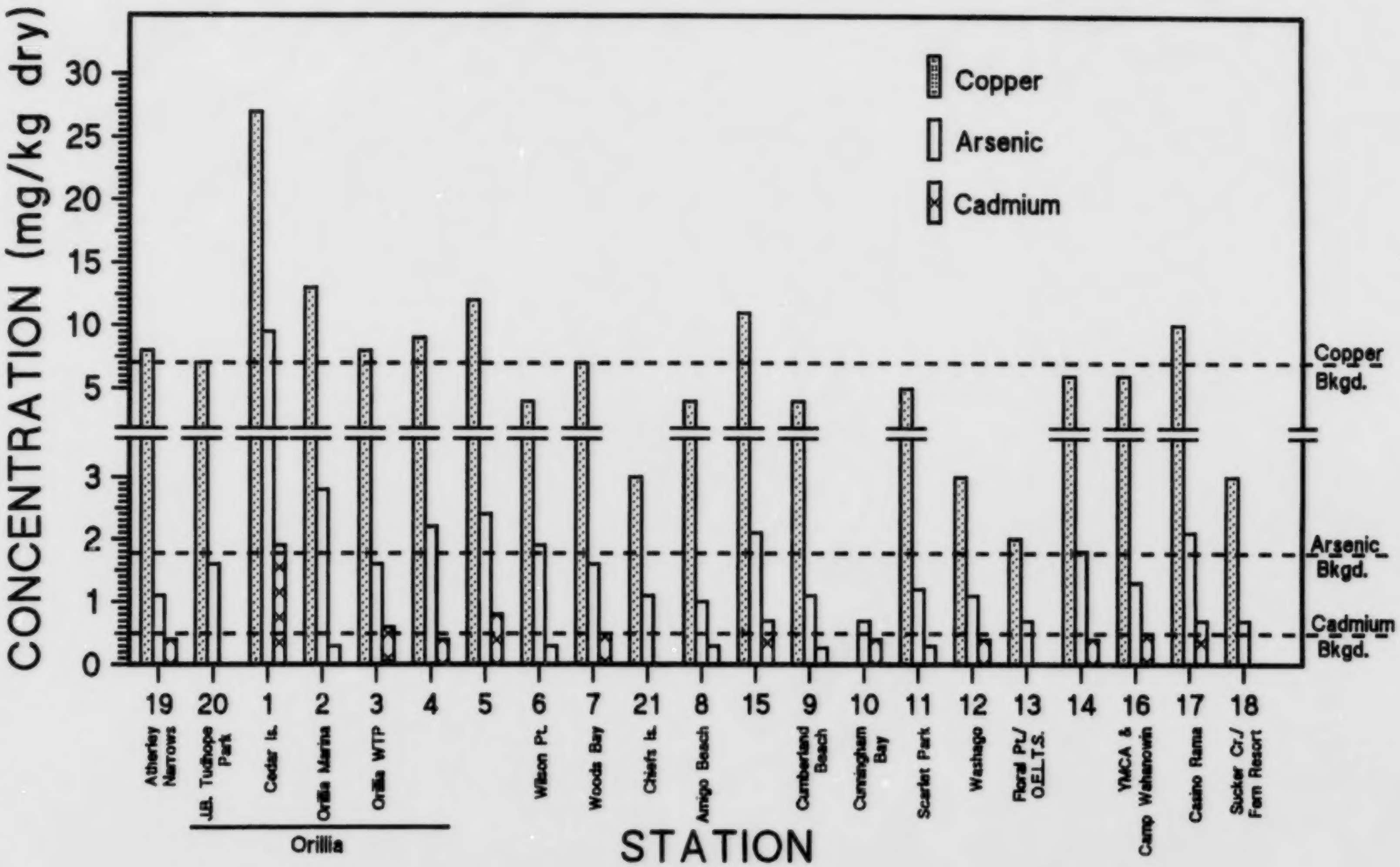

Figure 10. Spatial variations in surficial sediment concentrations of copper, arsenic and cadmium in Lake Couchiching. "Bkgd" = background concentrations from deep cores from Stations 5 and 15.

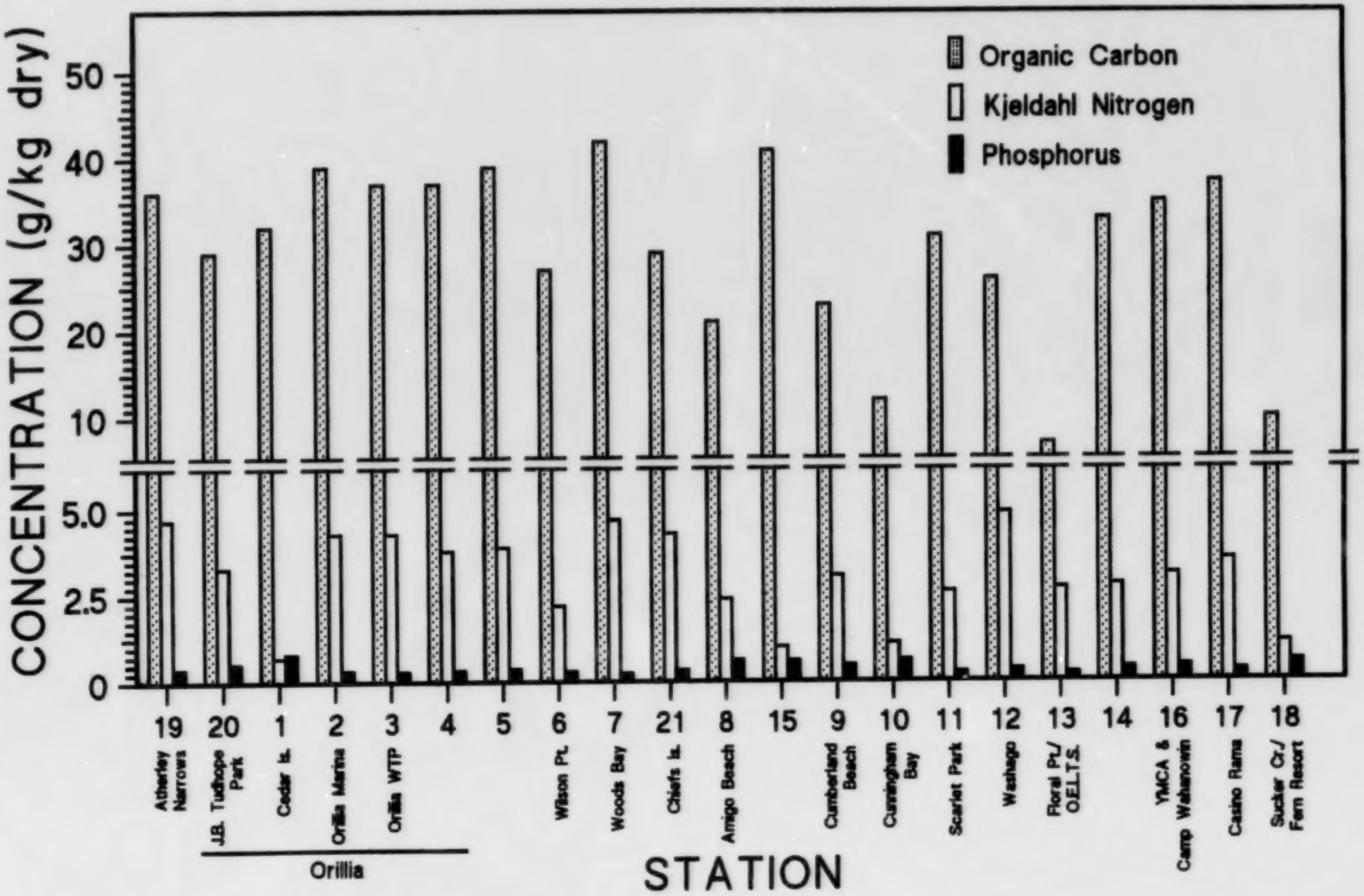

Figure 11. Spatial variations in organic carbon, Kjeldahl nitrogen and phosphorus concentrations in surficial sediments.

TKN concentrations were originally about 1 g/kg (Appendix E). Results for total organic carbon (TOC) are similar. The LEL for TOC is 1% or 10 g/kg. Concentrations of TOC in surficial sediments averaged 30 g/kg and ranged from 7 to 42 g/kg (Figure 11). Core data show that TOC concentrations were originally about 25-30 g/kg (Appendix E). Finally, phosphorus concentrations in surficial sediments have increased from historical concentrations of about 0.1 to 0.2 g/kg, to 0.3 g/kg (Figure 11). The PSQG LEL for phosphorus in sediments is 0.6 g/kg. As a result, phosphorus in sediments has been, and continues to be within acceptable limits. None of the nutrients exceed PSQG SEL concentrations (Appendix E).

Polycyclic aromatic hydrocarbons (PAHs) were detected at low concentrations in a few of the Lake Couchiching surface sediment samples. These were congregated in the south-west end near Orillia (Stations 1, 2, 3, 4 and 5) and at Stations14, 15, 17, 18, 19 and 20. Of the 16 compounds analyzed for, eleven (benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)-fluoranthene, benzo(g,h,i)perylene, benzo(a)pyrene, chrysene, fluoranthene, indeno(1,2,3,-cd)pyrene, naphthalene, phenanthrene and pyrene) were detected at one or more stations. Fluoranthene, indeno(1,2,3-cd)pyrene and pyrene were detected most frequently, i.e., at six to seven of the 21 stations. These included four stations at the south-west end of the lake (Stations 1 to 4), and the two in the deeper basins (Stations 5 and 15). With one exception however, concentrations of the individual compounds, as well as of total PAHs were below the respective PSQG-LELs. At Station 1, the concentration of indeno(1,2,3-cd)pyrene (240 μg/kg) was slightly above the PSQG-LEL of 200 μg/kg. Due to the relatively low PAH concentrations, core sections from Stations 5 and 15 were not analyzed for these compounds.

One surface sediment sample, from Station 2, off the Orillia water treatment plant intake and just north of the Orillia marina, was also analyzed for polychlorinated dibenzo-*p*-dioxins and furans (PCDD/Fs). Results indicated low concentrations of the different homolog groups, ranging from 5.6 ng/kg PentaCDD to 150 ng/kg for OctaCDD. The homolog distribution pattern is typical of combustion sources (Rappe, 1994). Concentrations of the toxic (2,3,7,8-substituted) isomers ranged from 1.3 ng/kg for 1,2,3,4,7,8-HexaCDF to 29 ng/kg for 1,2,3,4,6,7,8-HeptaCDD. The calculated 2,3,7,8-Tetra CDD Toxic Equivalence (TEQ) was 4.3 ng/kg, which is in the background range for the Great Lakes Basin (Reiner, OMOE LSB, pers. comm, 1998). This TEQ was obtained by multiplying the individual isomer concentrations by their respective International Toxic Equivalence Factor (I-TEF), which ranks toxicity relative to that of the most toxic isomer, 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin, assigned an I-TEF of 1.

Other persistent organic contaminants, including PCBs, organochlorine pesticides, phenoxy acid herbicides, chlorinated phenols, and chlorinated aliphatics and aromatics, were not detected in any of the Lake Couchiching surface sediment samples. Consequently, core sections from stations 5 and 15 were not analyzed for these contaminants.

Solvent extractables (a measure of fats, oils and greases, both natural and man-made) in surface sediments of the lake averaged 1074 mg/kg and ranged from 370 to 2200 mg/kg (Appendix E). No PSQG for the protection of benthic invertebrates is available to interpret these concentrations. However the Open Water Dredged Material Disposal Guideline of 1500 mg/kg can be used for comparison. Levels at six of the 21 stations were at or above this guideline. Four of these stations

(1 to 4) were in the south-west end of the lake, near Orillia; the remaining two were in Woods Bay (Station 7) and off James B. Tudhope Park, near Old Brewery Bay (Station 20). It should be noted that no petroleum hydrocarbons were found in any sediments from the lake (Method Detection Limit of 100 mg/kg), suggesting that the solvent extractables found in samples represent natural sources, such as lipids and fats resulting from decomposing plant and animal matter.

4.4 Plankton

4.4.1 Phytoplankton

The phytoplankton community was represented by 54 genera from six classes. No representatives of the Euglenophyta were found (Appendix G). Two marked periods of succession were observed (Figure 12). The chrysophyte, *Dinobryon sp.*, was the clear dominant of the early summer followed by *Uroglena sp.* This was followed by a clear genus shift which occurred in late July. *Uroglena sp.* replaced *Dinobryon sp.*. The Bacillariophytes (diatoms) dominated the community through the rest of the summer (Appendix G). *Rhizosolenia sp.* and *Cyclotella sp.*, were co-dominant in early August through September, when *Cyclotella sp.*, became the dominant diatom for the remainder of the year.

Through the early season the chrysophytes made up almost 95% of the community composition, but by mid-summer diatoms made up almost 71% of the community. Lake Couchiching phytoplankton communities were almost identical at the four mid-lake stations (Appendix G). Chrysophytes and diatoms were the dominant classes, and biovolumes were highest at Stations 5 and 15. Diatoms ranged in dominance between 27% and 43% of the population, while Chrysophytes ranged between 43% and 56% of the community composition (Appendix G).

Phytoplankton communities were generally similar among the open-lake stations, reflecting generally homogeneous water chemistry. Although Station 5 (nearest Orillia) had marginally higher nutrient levels, algal community composition was similar to the other three stations. Total algal biovolume at Station 5 was however approximately twice as high as at Stations 12 and 21 (Appendix G). At all stations, biovolumes were low, so nuisance algal levels were not observed.

Seasonal succession of algal communities in Lake Couchiching was markedly different from successions observed in more eutrophic areas such as Penetang Bay, (Gemza 1995a), (which is situated at the western extreme of the Severn River into which L. Couchiching empties) and Saginaw Bay, Lake Huron (Stoermer and Theriot 1985). In Saginaw Bay, diatoms bloom are dominant in spring, while dinophytes, chlorophytes and cryptophytes are dominant in the summer, and blue-green algae are dominant in the fall. In Penetang Bay of Severn Sound, *Melosira* sp. dominate the algal community, reflecting eutrophic conditions. In contrast, the diatom community in Lake Couchiching is dominated by *Cyclotella sp.*, which is usually associated with oligotrophic conditions.

4.4.2 Zooplankton

Zooplankton were represented by 15 species (Appendix H). Biomass peaked in mid June (84 mg/m^3), coincident with the clear water phase (Figure 13). A second biomass peak occurred in early September when the community was dominated by the calanoid, *Skistodiaptomus oregonensis*. Cyclopoid copepods (primarily *Diacyclops thomasii*) made up over 70% of the zooplankton community at that time. The zooplankton were composed primarily of calanoid and cyclopoid

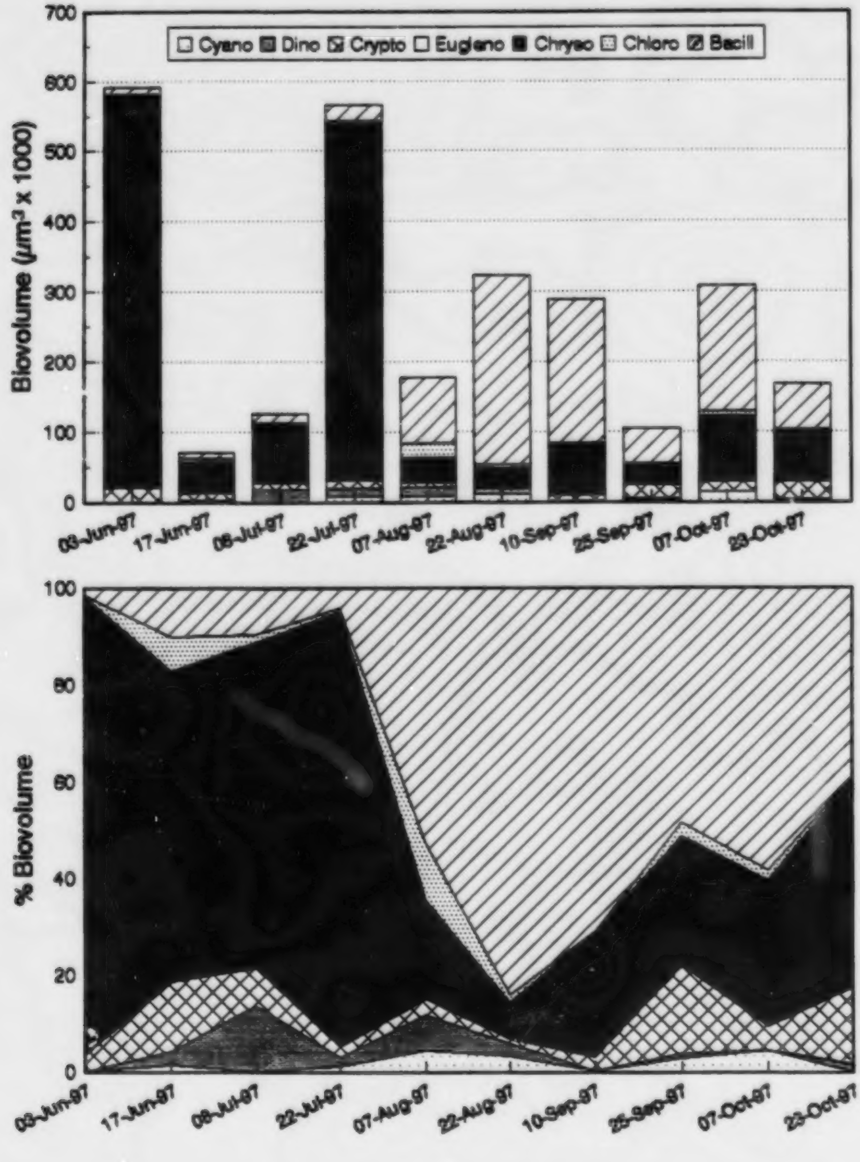

Figure 12. Seasonal trends in algal community composition at Station 5 in Lake Couchiching during 1997.

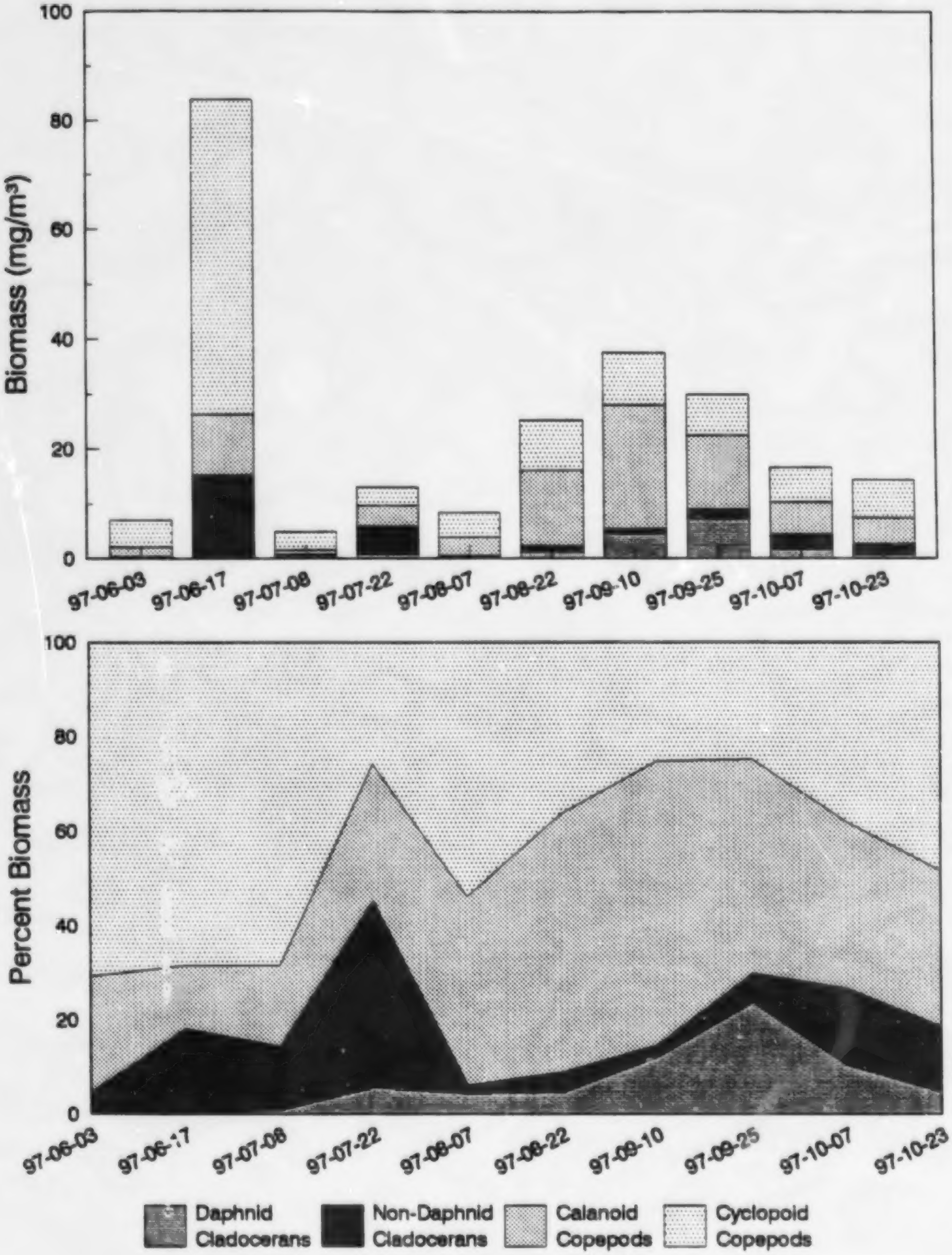

Figure 13. Seasonal zooplankton succession at Station 5 in Lake Couchiching, 1997.

copepods and non-daphnid cladocerans (*Bosmina longirostris*). Daphnid cladocerans made up almost 24% of the community in late September but usually constituted less than 10% of the community (Appendix H). The calanoid copepods, primarily *Leptodiaptomus minutus* and *Skistodiaptomus oregonensis*, succeeded the cyclopoids and non-daphnid cladocerans by early August (Appendix H).

In Lake Couchiching, zooplankton community composition was also characteristic of oligotrophic conditions. Increasing zooplankton biomass with increasing lake eutrophy is a well established phenomenon (Pace 1986). Eutrophic systems typically are dominated by smaller-bodied non-daphnid cladocerans such as *Bosmina spp.*, as well. Both trends indicating eutrophy were observed in Penetang Bay and across Severn Sound (Gemza 1995 b). Compared to eutrophic Penetang Bay where zooplankton biomass typically peaked at over 400 mg/m^3, zooplankton biomass in L. Couchiching only reached peaks near 80 mg/m^3, and typically ranged between 5 and 37 mg/m^3.

4.4.3 Zebra Mussel Veliger Larvae

Zebra mussels (*Dreissena polymorpha*) have a planktonic larval (veliger) stage. Between 1992 and 1995, the Ontario Ministry of Natural Resources (Lake Simcoe Fisheries Assessment Unit) monitored Lake Couchiching for the presence of zebra mussel veligers. The results of those surveys have yet to be released by the Ministry. During this 1997 survey, zooplankton collection utilized 80-μm mesh which is small enough to collect later-stage veliger larvae (larvae remain in the water column until they are about 200-μm long). In this survey, veliger larvae were first observed in the samples on June 17. On July 9, veliger larvae exceeded the biomass of other zooplankters (Appendix H). Of a total zooplankton biomass of about 18 mg/m^3, veligers constituted about 14 mg/m^3 of the total, with a density of over 16,000 veligers per m^3. On August 7 , the biomass of veliger larvae fell to about 9 mg/m^3. Through the remainder of the summer, veligers gradually fell in importance from about 40% of the zooplankton biomass to less than 20% (4.2 mg/m^3) by August 22. By September the planktonic veliger constituted less than 1% of the equivalent zooplankton biomass. Peak veliger densities were measured during the spring clear water phase, evident through June and July.

4.5 Macroflora

Aquatic macroflora (macroalgae and macrophytes) are important to lake systems because they provide food and habitat for fish and wildlife, cycle nutrients, assist in thermal regulation of the lake, are aesthetically appealing, and stabilize lake sediments (provide protection from wind-induced scour). In excess, macroflora can be detrimental by impeding boating and swimming, fouling shorelines with large mats of plant debris, and can cause degraded water quality as a result of decomposing organic matter (oxygen depletion) in bottom waters, and taste and odour problems in drinking water.

In Lake Couchiching, the macroalga *Chara* was the single most dominant form at 19 of 21 sampling locations. *Chara* was absent only at Stations 5 and 15 where water depths were 7 and 9 m respectively. At these two deeper stations, only the filamentous alga *Cladophora* was found. When found, beds of *Chara* were up to 50 cm tall (Appendix I). *Vallisneria americana*, (tape grass, wild celery), *Utricularia vulgaris* (bladderwort), *Najas flexilis* (bushy pondweed) and *Potamogeton richardsonii* (Richardsons pondweed) were also present at many stations (Appendix I). Broadleaf

forms of *Potamogeton* (*P. amphipolius*), *Elodea canadensis* (common waterweed) and *Myriophyllum spp*. (Eurasian Water Milfoil) were found at a few stations each (Appendix I).
The presence of *Najas flexilis* (bushy pondweed) increased significantly between July and August. Fragments of this plant were commonly observed floating on the surface of the lake in August , and a wind row 1m wide and approximately 15 cm thick was observed fouling the beach near the Orillia water treatment plant.

The plant growth in nearshore areas and around islands was variable. Luxuriant growths of *Vallisneria americana* and *Elodea canadensis* and *Spirogyra* (a filamentous green alga) were present near the marina at Orillia. This area is sheltered by break walls that reduce wave action and receives stormwater discharges from Orillia. *Myriophyllum spicatum* was growing in the south end of the lake, especially near the Narrows in the areas receiving incoming flows from Lake Simcoe. Heavy growths in the Narrows area interfered with the operation of the boat. The shallow sand areas around Chiefs Island were void of plants in many areas or produced sparse growths of *Chara sp*.

The three depth sounder transects further characterized the dominance of the macrophyte *Chara* at depths between 1 and 6 m. Only the filamentous green alga *Cladophora* and the odd plant sprig was documented by grapnel in depths greater than 6 metres. While the depth sounder recorded nearly continuous plant growths over the bottom in depths less than 6 m, it also documented that plant growths did not reach the surface in the open sections of the lake. Luxuriant plant growth in nearshore areas appeared to be limited to narrow bands and patches. The dominant plants, *Chara* and *Vallisneria americana* are not nuisance plants. *Chara* grows on the bottom, and is rarely found in the upper water column. The ribbon-like leaves of *Vallisneria americana* sometimes reach the surface, but usually only the slender coiled flower stalks are present on the surface in August.

The presence of the filamentous green alga *Spirogyra* was commonly noted in the south portion of the lake. This plant grew on (fouled) the aquatic macrophytes and *Chara sp*. beds. Large billowy clouds of this alga were present on the sandy substrates near the breakwalls around the marina at Orillia and in the bay areas between the marina and the narrows near the incoming flows from Lake Simcoe (Figure 14). Past plant studies by Veal and Jones (1972) did not document significant growths of *Spirogyra*. Large growths of filamentous green algae (i.e., *Spirogyra*)can result in water quality problems including loss of recreational potential (i.e., swimming) and loss of habitat for fish and wildlife (fouling of plant beds and bottom substrate). Large amounts of *Spirogyra* and other filamentous green algae also have the potential to reduce dissolved oxygen levels during night time, due to respiration.

During the plant survey, large numbers of zebra mussels were observed throughout the lake . Small mussels from 2 to 10 mm long were commonly found on macrophytes, particularly *Chara sp*.
In 1972, *Myriophyllum* was the single most dominant (79% of stations) and abundant plant (Veal and Jones, 1972). *Chara*, *Vallisneria americana* and *Najas flexilis* were less abundant, but still prevalent. In 1997, *Myriophyllum* was not abundant or prevalent, being found at only a single station (19) at the inflow of Lake Couchiching. In 1972, the species of *Myriophyllum* was probably *M. spicatum* (Eurasian Water Milfoil). This exotic plant clogged several lakes in Southern Ontario with growths impeding operation of water craft (Wile et al., 1979). At some lakes, mechanical harvesting was

Figure 14. Underwater photo of a benthic algal growth at Station 2 in Lake Couchiching

implemented to cut channels for boat access through the plant beds (e.g., in Rondeau Bay, Lake Erie, Chemong Lake). The movement (invasion) of this plant into Southern Ontario was underway in 1971 (Chemong Lake) and peaked in the late 1970's. The decline in abundance of *Myriophyllum* in Lake Couchiching is typical. This plant has similarly disappeared from or declined in other lakes in Ontario and the north western United States (Aiken et al., 1979; Carter, 1979).

Scirpus acutus (hardstem bullrush) was present in many shallow (less than 1 m depth), sandy, nearshore and island areas of the lake. Large beds of this plant were present around Chiefs Island and in the south end of the lake in the vicinity of the narrows. No attempt was made to sample or totally quantify the presence of this emergent plant. These observations are similar to those by Veal and Jones (1972).

Overall, the aquatic macroflora study documented a healthy plant community in Lake Couchiching dominated by the native plants *Chara sp.*, *Vallisneria americana*, *Najas flexilis* and *Utricularia vulgaris*. These plants provide food and habitat for fish and wildlife and provide many water quality benefits (e.g., increased water clarity and algae control). They are present throughout the lake with the exception of the two deep basins (where insufficient light reaches the bottom) which are located to the north and south of Chiefs Island. These deeper areas (greater than 6m in depth) had a thin layer of filamentous green alga *Cladophora sp.* on the surface of the silt, muck substrate.

4.6 Benthic Macroinvertebrates

This study documented 96 distinct taxa from 22 major taxonomic groups (Appendix L). In general, most samples contained the common amphipod *Hyalella azteca*, a good variety of chironomids (midges), the mayfly *Caenis punctata*, a few Leptoceridae (Trichoptera), an assortment of gastropod molluscs (snails) and a large number of adult zebra mussels (*Dreissena polymorpha*) (Appendix J, Figure 15). The generally uniform substrate of silty sand, with a high mollusc shell content and dense mat of the aquatic plant *Chara* was probably responsible for the generally uniform benthos. Total numbers of benthos ranged from just over 7,000 m^{-2} to just under 100,000 m^{-2} (Appendix J), while the number of taxa per sample ranged from 14 to 28. Diversity was relatively high, ranging from 1.98 at one of the deeper stations (Station 5) to 3.68 at Station 4.

None of the benthos found in the lake were unusual, although the dominant mayfly in the lake (*Caenis punctata*, Provonsha, 1990) is of interest taxonomically. Specimens from Lake Couchiching have features that resemble *Caenis youngi*, and were similar to specimens observed near Sault Ste. Marie (Morton, pers. comm.). Provonsha (pers. comm.) suggests that those with similarities to both *C. punctata* and *C. youngi* may actually be the undescribed nymphs of *Caenis candida*.

Zebra mussels were dominant members of the benthic community at all stations (Figure 15) with numbers ranging as high as 60,000 m^{-2} (Appendix J). Most of these zebra mussels were associated with *Chara*, actually being attached to the macroalga. So far, abundances of zebra mussels in Lake Couchiching are not extraordinary. Zebra mussel populations have exceeded 200,000 m^{-2} on hard substrate in Lake Erie (Dermott et al., 1993), but are typically lower (10,000 m^{-2}) on soft substrate (e.g., Griffiths, 1993).

Figure 15. Map of Lake Couchiching showing the percent composition of major groups of benthic macroinvertebrates at each station in 1997.

The arrival of zebra mussels in Lake Couchiching has the potential to alter both biological and physico-chemical aspects of the lake. The date of entry of zebra mussels into the lake has not been confirmed (Ron Allan, OMNR, Lake Simcoe Fisheries Assessment Unit, pers. comm.). However, some of the "baseline" characteristics described in this survey may already reflect the presence of zebra mussels. The change in lake clarity since 1977 is a good example (Section 4.2.3). Such changes in clarity are typically followed by effects on local sediments and fauna. For example, in Lake Erie, increased clarity has caused walleye to seek deeper (darker) water. In addition, the filtering ability of zebra mussels shifts a lot of energy from the water column to the sediments where it is more available to benthic organisms. In Lake St. Clair, increased water clarity is considered one reason plant growths have increased (Griffiths, 1993). In Lake Erie, Dermott et al. (1993) demonstrated that benthic communities in the vicinity of zebra mussels were more abundant. Via production of pseudofaeces, zebra mussels also have the potential to alter sediment type (make sediments finer) and increase contaminant concentrations in sediments (Howell et al., 1996).

Most of these effects on fish, plants and small benthos are fairly subtle in relation to the effects zebra mussels have on large Unionidae. Unionids are large bivalves that live in soft sediments, and like zebra mussels, filter water. In Lake Couchiching, the single species of unionid bivalve identified in the survey was *Lampsilis radiata* (Appendix L). Specimens of *L. radiata* were found at Stations 13 and 15 using the Ponar grab. Specimens were also observed (but not collected in the Ponar samples) at Station 21. At that station, the "bed" of unionids started in about 2 m of water, while between 3 and 4 m, several hundred unionids were apparent. Zebra mussels tend to use unionids as a substrate for attachment. Large numbers of mussels can occlude the siphon apparatus of unionids, effectively killing them (Mackie, 1991; Gillis and Mackie, 1994). Severe negative impacts on *L. radiata* can therefore be expected as a result of the introduction of zebra mussels into Lake Couchiching.

In addition to the effects of zebra mussels on biological systems, zebra mussels have also been known to foul domestic and industrial water intakes. For those municipalities with drinking water intakes, the die-off of zebra mussels inside pipes can lead to taste and odour problems unrelated to those associated with increased algal growths (Katona, 1998). Treatment of water inside intake systems can control infestations beyond the point of intake. In municipal intakes, the use of alum to remove suspended solids also removes veliger larvae from the water column (Mackie and Kilgour, 1995). Low levels of chlorine added to intake water during settling periods (mid-summer) also prevents the settlement and attachment of mussels inside water intakes and distribution systems (Claudi and Mackie, 1994). Finally, zebra mussels do tend to be fairly abundant and when they die, their shells may wash up on shore. As a result, beaches can be less attractive for swimming and walking due to shell debris.

The ability of zebra mussels to filter and clarify lake water may be associated with changes in the taste and odour of drinking water taken from the lake. Increased light penetration should increase the production of macroflora, as well as benthic algae and bacteria. As discussed, growths of algal near the bottom of the lake have been observed.

The benthic fauna of Lake Couchiching generally reflect a slightly mesotrophic condition (Appendix J). This conclusion is based, in part, on the low numbers of tubificid worms. Tubificids are typically

found in high numbers in eutrophic conditions (Howmiller, 1977; Milbrink, 1983). The conclusion of slight mesotrophy is also based on the complex of chironomid taxa found (Appendix J). The high proportion of Orthocladiinae chironomids (especially *Epoicocladius*), the Tanytarsini chironomids *Stempellina* and *Zavreliella* suggest relatively high water quality, since these taxa are sensitive to eutrophication (Saether, 1979; Bode, 1988). The most dominant chironomids included *Chironomus*, *Dicrotendipes*, *Paratendipes*, *Tanytarsus*, and *Procladius*. All but *Tanytarsus* are reasonably tolerant of eutrophic conditions, implying that the lake is at least to some degree eutrophied. Finally, mesotrophy can be assumed based on the abundances of organisms at all stations. Typically, oligotrophic lakes can support only up to about 2,000 benthic organisms m^{-2} (Dermott, 1985; Dermott et al., 1986). In Lake Couchiching, numbers were generally in excess of about 20,000 m^{-2} (Appendix J).

Spatial variation in benthic community composition in Lake Couchiching was apparent (Figure 15) but was unrelated to any of the chemical measurements made of water or sediments. As such, much of the observed variation in benthic community composition can be considered natural for the lake. The single physical factor that did tend to correlate with variation in benthic communities was depth. Although all stations were dominated by zebra mussels, benthic communities from the deep stations (5, 15, 17) had benthic communities with higher proportions of the phantom midge *Chaoborus punctipennis*. Two of these stations (5 and 15) also tended to have higher proportions of sphaeriid or fingernail clams (*Pisidium*), the snail *Helisoma anceps* and the chironomid *Paracladopelma*. The benthic fauna at Station 19 was unique. Station 19 was shallow (1.7 m depth) and near the inflow from Lake Simcoe. The benthic fauna there had relatively high proportions of isopods (*Lirceus lineata*, *Caecidotea racovitzae*), snails (*Viviparous georgianus*) and worms (*Limnodrilus clarapedianus*). All of these taxa are reasonably tolerant of high nutrient concentrations, but *L. lineata* tends to be found in cooler water. The fauna at this station are unique because it receives water from Lake Simcoe, which is a little cooler.

Chironomids, which are generally fairly tolerant of degraded water quality, were more dominant at Stations 8, 12, 16 and 18. The fauna at Station 18 was primarily composed of chironomids (midges; Figure 15). Chironomids may be prevalent at Station 8 because Robinson Creek discharges at that point. Benthic fauna at creek outlets can be expected to be somewhat unique because the discharges are a source of allochthonous organic matter. High proportions of the benthic fauna at Stations 16 and 18 may be reflecting impaired water quality at these locations.

Overview of Environmental Quality

5. OVERVIEW OF ENVIRONMENTAL QUALITY

Lake Couchiching is a basic, hardwater lake. Primary production in the lake is limited by phosphorus, since water-borne phosphorus concentrations are low. In general, the lake can be classified as either oligotrophic or slightly mesotrophic based on good water clarity, low nutrient concentrations, and a suite of organisms (phytoplankton, zooplankton, benthos) that are typically associated with oligotrophic to slightly mesotrophic conditions. Bacterial (i.e., faecal coliform) levels in the lake were low, such that swimming is of high quality. Oligotrophic lakes are the most desirable from a recreational standpoint because of the high clarity. They also tend to support large sport fish because oxygen concentrations are high throughout the year, even in deep water. Mesotrophic lakes are characterized by moderate growth of algae and aquatic plants. They are suitable for the pursuit of water oriented recreational activities but have the potential to develop periodic algal blooms.

The lake has been exposed to anthropogenic sources of both metals and organic contaminants. Sediment core samples demonstrated significant increases in levels of chlorides, nutrients and metals in the most recently deposited sediments. These increases appear to be most localized near Orillia, and probably originate from urban runoff. Historically, sediment nutrients have been above PSQG LELs and are currently not above SELs. Water-borne nutrient concentrations are below concentrations that are typically associated with nuisance growths of algae. Metal levels are also generally below provincial water quality objectives and sediment LELs. Metal levels in water and sediments should therefore have no adverse effects on the biological systems of Lake Couchiching.

Contamination by organic compounds in Lake Couchiching is at low levels. Some marginal elevation of levels of oil and grease was demonstrated in more recent lake sediments, but these increases were associated with natural sources such as lipids and fats resulting from decomposing plant and animal matter. Atrazine was found at trace levels in water along the western shore. This herbicide originates from agricultural practices and is non-persistent. Observed trace amounts of atrazine do not pose ecological or human health risks. PAHs were detected at low concentrations in a few of the Lake Couchiching surficial sediment samples. PAHs were detected primarily in the south-west end of the lake near Orillia. With one minor exception, concentrations of the individual compounds, as well as total PAHs were below the respective LELs. Persistent organic contaminants including PCBs, organochlorine pesticides, phenoxy acid herbicides, chlorinated phenols, and chlorinated aliphatics and aromatics were not detected in any of the surface sediment samples. Organic contaminants in Lake Couchiching should therefore pose no ecological or human health risks.

Even though metal levels were low, there is still evidence that at least mercury is biologically available and biomagnifies in the food chain. Routine monitoring by the OMOEE (1997) shows that mercury levels in large specimens of smallmouth bass, largemouth bass, northern pike, walleye and yellow perch are elevated with consumption restrictions. Mercury levels in mid-lake surface sediments are elevated above historical levels, but remain below LELs.

The flora and fauna of Lake Couchiching are fairly typical for lakes in central Ontario. During the 1970s, macrophytes were dominated by Eurasian Water Milfoil. Since then, prevalence of this exotic species has declined. Another exotic, the zebra mussel (*Dreissena polymorpha*) is now a numerically dominant organism in the lake. Zebra mussels were shown in the 1997 survey to be dominant in both

the benthos and plankton. Typically, zebra mussels adhere to hard substrate, but will attach to plants. With the macrophyte *Chara* prevalent at almost all stations, zebra mussels used the *Chara* as substrate. Zebra mussels present the most immediate environmental concern in the lake since it has the potential to not only alter biological processes in the lake, but to also interfere with domestic and industrial water uses, and recreation.

Recommendations

6. RECOMMENDATIONS

Recommendations

The third objective of this report is to provide recommendations concerning possible impacts associated with future development. With increasing development, there is the potential for alterations in water quality to occur. Some of the more significant sources of water quality impairment include:

- i) soil erosion and sedimentation from construction activities
- ii) increased contaminant, bacterial, and suspended solids loadings from storm-water runoff
- iii) increased phosphorus loadings from future development (municipal sewage)
- iv) streambank erosion in new developments
- v) introduction of exotic species
- vi) loss of aquatic habitat through shoreline development

Based on the predicted impacts of development and on the results of the survey, the following recommendations are made.

Recommendation 1: Further confirmation and investigation of sites where impairment was demonstrated.

Biological impairment was evident at Station 16 and at Station 18. Further confirmation and investigation of impairment at these two locations by the Ministry of the Environment is warranted.

Recommendation 2: Implement appropriate management practices to minimize water quality impairment

Water quality impairment from development can be minimized through proper planning, education and mitigation. In this regard, the Ministry of the Environment is conducting meetings with Municipalities, conservation authorities and consultants in Simcoe County.

Recommendation 3: Develop a monitoring program to track long-term changes due to the trophic status of the lake.

In order to assist area municipalities in making prudent planning decisions, the Ministry of the Environment will conduct periodic biological and chemical monitoring in Lake Couchiching.

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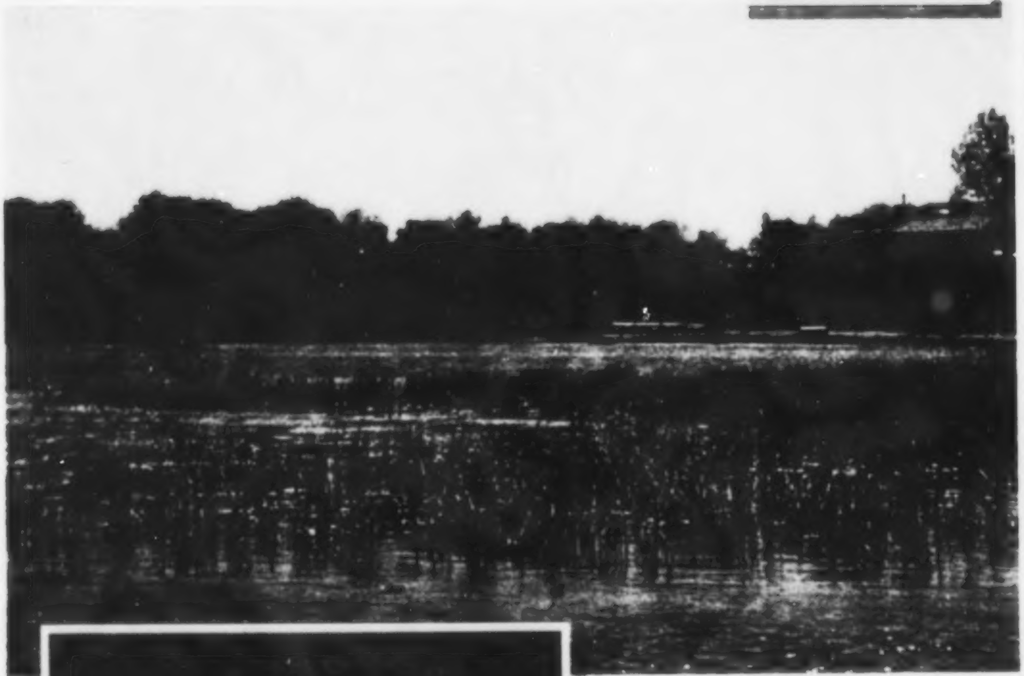

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Appendix A

Appendix A - Wastewater Discharges to Lake Couchiching

List of Tables

Table A.1 Wastewater discharges to Lake Couchiching

Facility	Discharge			Effluent Criteria/Objective, mg/L or organisms/Dl					
	Treatment	Type	Discharge Point	BOD	S.S.	T.P.	T. NH^3	Chlorine	*E. coli*
Casino Rama STP	mechanical tertiary, with UV disinfection	continuous	400 m offshore	<10	<10	<0.15	<3	ND	<100
Casino Rama stormwater	wetland	intermittent	Marina watercourse (East Branch)						
Casino Rama WTP	packaged, conventional	backwash			<15				
YMCA Geneva Park STP	three-cell lagoon	seasonal: spring & fall	into bay	15	20	0.5			
Camp Wahonowin STP	single facultative lagoon + alum	seasonal: spring or fall	into wetland & then into lake via two culverts	25	25	1.0			
Fern Resort Ltd. STP	single-cell lagoon + alum	seasonal: spring & fall	into Sucker Creek						
Ontario Educational Leadership STP	extended-air STP	seasonal							

Appendix B

Appendix B - Preliminary Reconnaissance Survey Results for Candidate Sampling Locations.

List of Tables

Table B.1 Preliminary Reconnaissance Survey Results for Candidate Sampling Locations.

Station			Depth, metres	Ponar Fullness	Sediment Characteristics	Debris	Flora		Fauna							
Recon. No.	Final No.	Location/Description					*Chara*	Other	Amphipod	Isopod	Chironomid	Burr. Mayfly	Snail	Clam	Mussel	Other
1		off Orillia marina	3.0	3/5	grey, very silty, organic	calcareous; wood chips; snail & fingernail clam shells	√ (+Ca)			√	√ (red)			fingernail, *Corbicula*	*Dreissena*	
2		middle of Pumpkin Bay	1.8	5/5	grey, sandy, silty, jelly-like ooze; H_2S odour	calcareous; snail & fingernail clam shells	√	tubers		√	√ (red)				*Dreissena* (many on *Chara*)	
3		north of Couchiching Beach Park	3.0	5/5	grey, sandy, silty, jelly-like ooze; H_2S odour	calcareous; *Corbicula* shell	√ (abundant & finer)		√		√ (red & green)				*Dreissena*	
4		south of Tafton	3.4	5/5	grey, sandy, silty ooze; slight H_2S odour	calcareous (abundant); unionid shell	√ (abundant)	tubers			√			fingernail	*Dreissena*	
5		in bay south of Wilson Pt.; off boat channel	1.8	5/5	grey, silty, gritty ooze (more sand)	calcareous; unionid shells	√	tubers	√		√	√			*Dreissena* (larger)	
6		off Wilson Pt., near red buoy	2.7-3.0	5/5	more brown-grey, silty ooze; slight H_2S odour	calcareous; *Corbicula* & fingernail clam shells	√ (abundant)	tubers			√ (red)	√ (large)	*Helisoma, Physa*	fingernail	*Dreissena* (smaller, on *Chara*)	crayfish (*Orconectes*)& Johnny Darter
7		Woods Bay, off radio antenna & Happyland	2.4	5/5	grey, silty ooze	calcareous; snail & fingernail clam shells	√ (very abundant)	tubers - *Potamogeton*?			√ (red)	√			*Dreissena* (small, on *Chara*)	leech
8		off Amigo Beach	1.5	5/5	grey, silty ooze; H_2S odour		√				√ (red)			fingernail (*Sphaerium*)	*Dreissena* (small, on *Chara*)	
9		Cumberland Beach, off brown cedar cottage with fence	1.8	5/5 ?	darker grey, sandy silt	calcareous; shells	√				√		*Helisoma*	fingernail (*Sphaerium*)	*Dreissena* (large, on *Chara*)	dragonfly, large worms & darter
10		south of Scarlet Park	3.4	3/5	grey-black, sandy silt; some H_2S odour	calcareous	√ (abundant)				√	√ (large & small)	*Lymnaea*		*Dreissena* (large & small)	dragonfly & sponge
11		north of Scarlet Park	1.8	5/5	grey, sandy silt	calcareous	√	*Potamogeton*			√ (red & green)	√ (large)		fingernail (*Pisidium*)	*Dreissena*	dragonfly, large worms & leech
12		Washago, north of green buoy No. 263	2.7	5/5	grey, sandy silt	calcareous (abundant)	√ (abundant)				√	√ (abundant)		fingernail (*Sphaerium*)	*Dreissena*	
13		Floral Park	2.1	5/5	grey, sandy silt; large rock outcrops	calcareous	√ (abundant)				√ (red)	√		fingernail	*Dreissena* (on *Chara*)	
14		bay at YMCA Camp	3.0	4/5	grey, more sandy silt	calcareous, abundant bark, unionid shell	√	tubers			√ (red)	√ (large)	*Helisoma*		*Dreissena*	large worms
15		off flashing red buoy	9.1	5/5	grey, fine, silty ooze	snail, fingernail clam & unionid shells					√	√		fingernail (*Sphaerium*)	*Dreissena*	
16		Geneva Park	1.5	5/5	grey, soft, silty ooze	calcareous; unionid shell		*Potamogeton*			√		*Amnicola, Helisoma, Physa*		*Dreissena*	
17		off mouth of Sucker Cr., south of Fern Bay	1.5	3/5	grey, sandy, silty ooze; H_2S odour	calcareous; clam & unionid shells, wood	√				√ (red)				*Dreissena*	
18		north of Atherley, off Couchiching Point	1.5	4/5	brown, silty sand			*Myriophyllum, Elodea*	√ (abundant)		√		*Bythinia, Cincinnatia*	fingernail	*Dreissena*	large worms
19		off Moose Beach	2.1	4/5	grey, silty ooze	clam & unionid shells	√				√			fingernail	*Dreissena*	crayfish

Appendix C

Appendix C - Station Location Information

List of Tables and Figures

Table C.1. Sampling Locations and Coordinates.

Station Number	Location / Description	Water Depth, m	Metres from shore	Coordinates (NAD83) Northing, m	Easting, m
1	west shore, 70 m southeast of Orillia Marina break wall; off Cedar Island	2.0		4941010	626400
2	west shore, off Couchiching Beach Park	2.8	150	4941690	626081
3	west shore, 300 m north of Orillia water intake structure	2.7	300	4942327	626123
4	west shore, off Tafton; 525 m off Wilson Point	2.2		4943947	626076
5	in centre of south basin; 1000 m south of Chiefs Island	9.0		4944015	628261
6	west shore, halfway between red buoy SC6 and Wilson Point	3.2		4944651	626586
7	west shore, off Woods Bay	2.1	300	4945263	626186
8	west shore, off Amigo Beach	1.4	240	4949501	627734
9	west shore, off Cumberland Beach Point	2.1		4950735	628064
10	west shore, in centre of Cunningham Bay	1.8	240	4951596	628278
11	west shore, off small tributary north of Scarlet Park	2.0	430	4953889	630121
12	north end, 120 m east of green buoy S263 (Washago)	1.7		4955588	631488
13	east shore, off Floral Point	1.8	125	4953966	631163
14	east shore, off YMCA camp, in centre of small bay south of Floral Park	3.2	80	4951427	631186
15	in centre of north basin; 1200 m northwest of Geneva Park Point	9.8		4949644	628766
16	east shore, off Geneva Park	1.5	115	4948143	630197
17	east shore, off Casino Rama WTP & at discharge	6.8	435	4945939	629840
18	east shore, off mouth of Sucker Creek	1.4	110	4943206	630323
19	south end, 400 m south of Nadie Island; east of buoy S305 (Atherley)	1.8		4941423	629450
20	south end, off Moose Beach	2.1	200	4940769	627811
21	middle, in bay north of Chiefs Island	2.6		4945912	628132

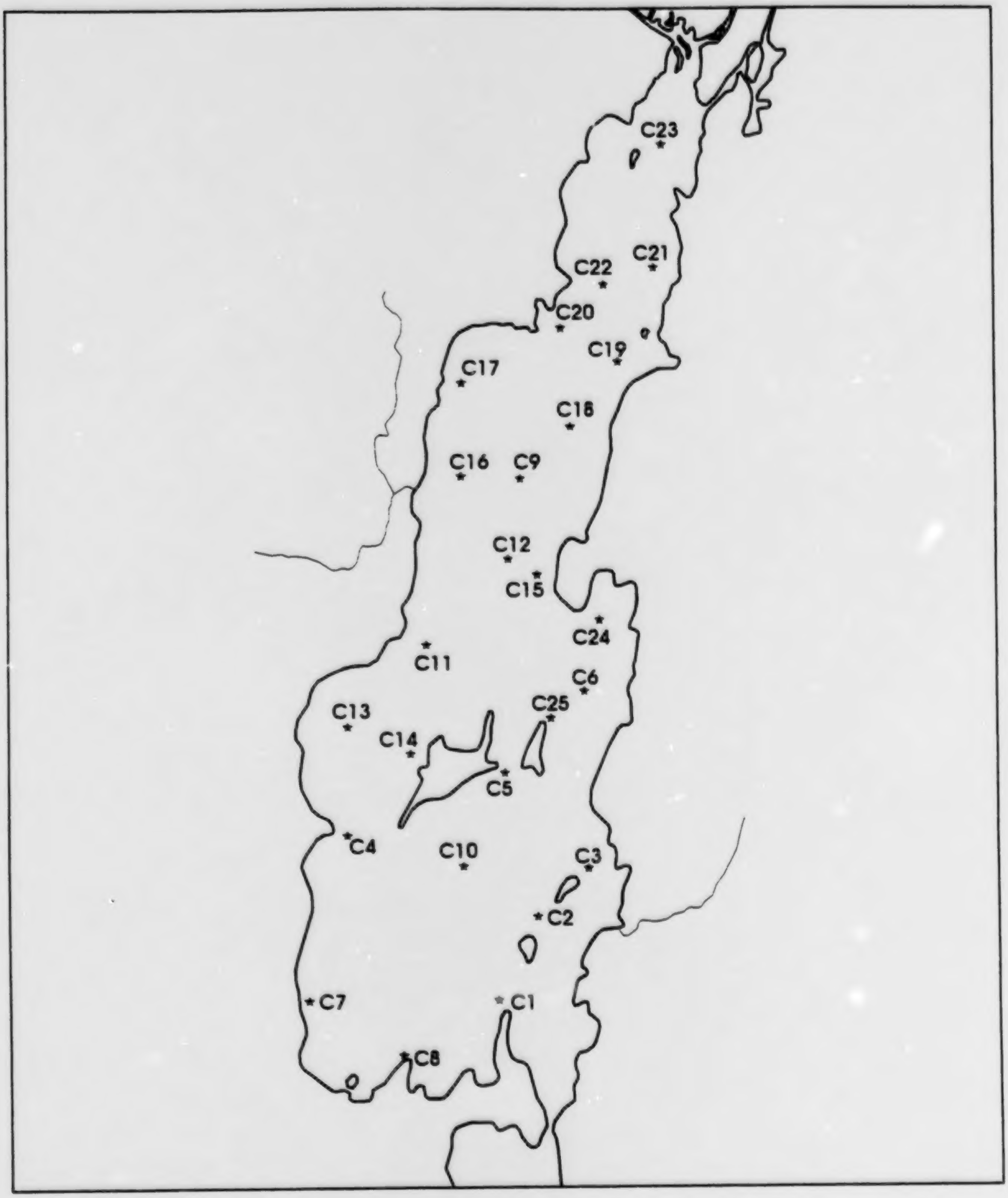

Figure C-1. Map of Lake Couchiching showing locations of the 25 stations at which currents were characterized.

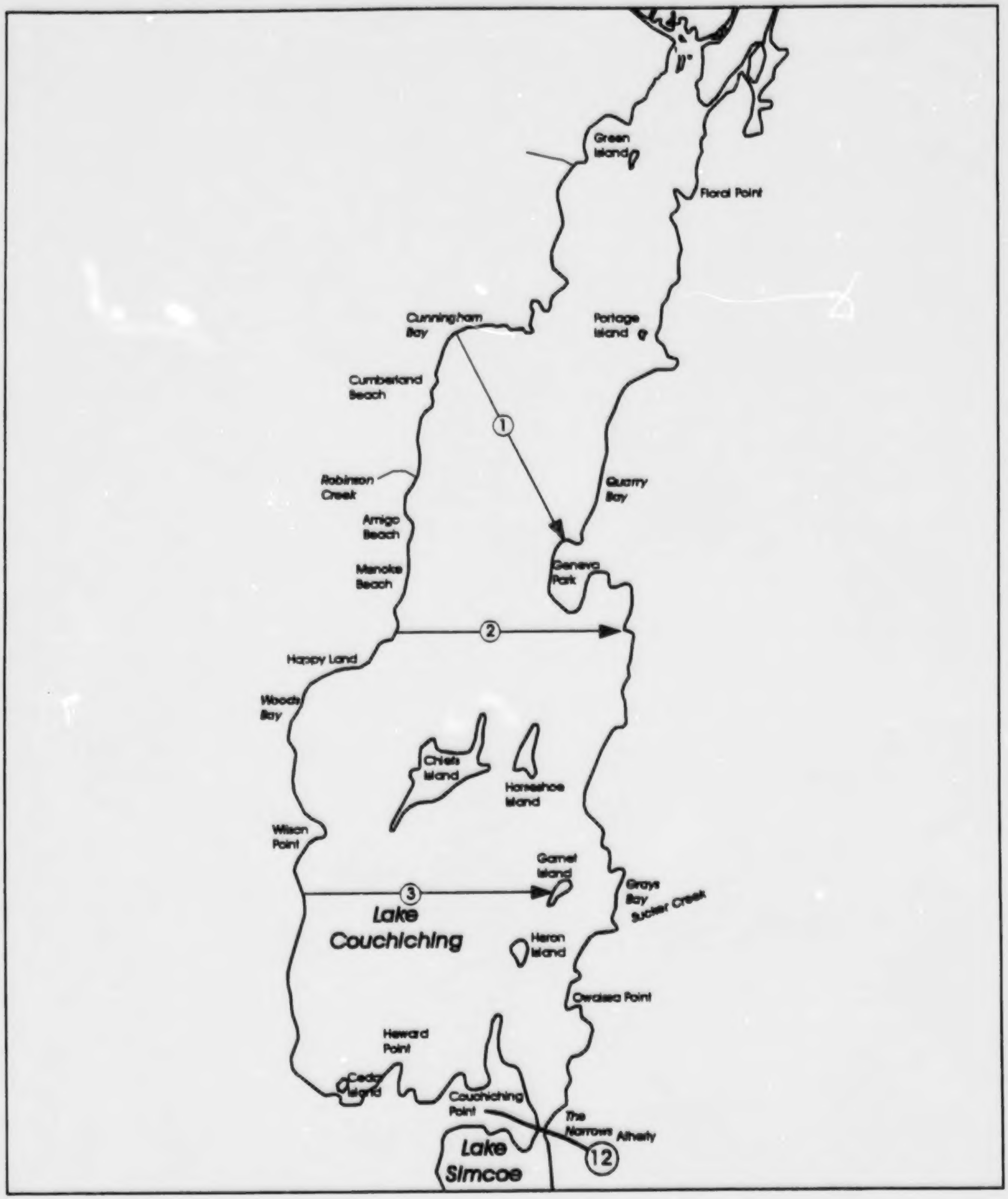

Figure C-2. Map of Lake Couchiching showing locations of the three transects along which macrophytes were characterized.

Appendix D

Appendix D Surface Water Quality and Current Data

List of Tables and Figures

Table D-1. On-board physical-chemical measurements of Lake Couchiching waters.

Concentration units as noted: mg/l = ppm; NTU = Nephelometric Turbidity Units.

Station Number	Sample Date	Field Sample Number	Water Depth, m	Sample Depth, m	Temperature degrees C	pH -log[H+]	Oxygen, dissolved mg/l	Oxygen, % saturation	Conductivity umhos/cm@25C	Turbidity NTU	Current Speed cm/sec	Current Direction magnetic North
1	97/06/03	76837	1.90	0.30	15.31	8.51	10.76	107.6	339	4.2	--	--
"	"	"	"	1.00	15.33	8.50	10.75	107.6	339	4.5	--	--
"	"	"	"	1.50	15.31	8.51	10.80	108.0	339	4.5	--	--
"	97/05/28	--	"	1.75	14.50	--	--	--	--	--	0.0	145
"	97/07/08	48619	1.90	0.30	20.27	8.13	8.36	92.6	329	0.0	--	--
"	"	"	"	1.50	20.25	8.26	8.43	93.3	329	0.0	--	--
2	97/06/03	76838	2.70	0.50	15.34	8.52	10.84	108.4	339	4.6	--	--
"	"	"	"	1.00	15.34	8.49	10.80	108.4	339	4.6	--	--
"	"	"	"	2.00	15.29	8.49	10.90	108.4	339	4.6	--	--
"	"	"	"	2.40	15.28	8.49	10.90	108.4	339	4.5	--	--
"	97/05/28	--	"	2.55	15.63	--	--	--	--	--	0.6	131
"	97/07/08	48618	2.80	0.40	20.19	8.17	8.07	89.2	330	0.0	--	--
"	"	"	"	1.50	20.22	8.22	8.08	89.4	330	0.0	--	--
"	"	"	"	2.50	20.21	8.22	8.04	88.9	330	0.0	--	--
3	97/06/03	76839	2.80	0.30	15.57	8.45	10.79	108.5	338	4.5	--	--
"	"	"	"	1.10	15.60	8.47	10.73	107.9	338	4.3	--	--
"	"	"	"	2.00	15.47	8.49	10.89	109.2	337	4.4	--	--
"	97/05/28	--	"	2.65	15.93	--	--	--	--	--	0.0	30
"	97/07/08	48617	2.50	0.60	20.39	8.10	7.94	88.1	331	0.1	--	--
"	"	"	"	1.60	20.38	8.18	7.95	88.2	331	0.5	--	--
"	"	"	"	2.20	20.37	8.19	7.96	88.3	332	0.6	--	--
4	97/06/03	76840	2.00	0.50	15.95	8.33	10.10	102.3	338	5.7	--	--
"	"	"	"	1.00	15.98	8.37	10.12	102.6	338	5.8	--	--
"	"	"	"	1.50	15.96	8.34	10.09	102.2	338	8.5	--	--
"	97/05/28	--	"	1.85	16.85	--	--	--	--	--	3.0	190
"	97/07/08	48616	2.00	0.30	20.17	8.20	8.28	91.5	330	0.0	--	--
"	"	"	"	1.50	20.16	8.24	8.37	92.5	331	0.0	--	--
5	97/06/03	76841	9.20	0.50	14.69	8.58	8.01	79.0	339	4.3	--	--
"	"	"	"	1.20	14.66	8.51	7.06	69.6	339	4.3	--	--
"	"	"	"	2.00	14.63	8.50	6.72	66.2	339	4.1	--	--
"	"	"	"	3.00	14.64	8.54	6.69	65.9	339	4.1	--	--
"	"	"	"	4.00	14.48	8.48	6.43	63.1	339	4.5	--	--
"	"	"	"	5.00	14.46	8.55	6.26	61.4	339	4.7	--	--
"	"	"	"	6.00	14.42	8.49	6.15	60.3	339	4.5	--	--
"	"	"	"	7.10	12.87	8.42	6.26	59.3	338	4.6	--	--
"	"	"	"	8.00	12.31	8.39	6.29	58.9	339	4.9	--	--
"	97/05/28	--	"	9.05	13.68	--	--	--	--	--	0.0	95
"	97/07/08	48615	9.00	0.30	20.60	8.23	8.29	92.4	331	0.0	--	--
"	"	"	"	1.00	20.60	8.25	8.31	92.6	331	0.0	--	--
"	"	"	"	1.90	20.60	8.27	8.31	92.5	331	0.0	--	--
"	"	"	"	4.00	20.60	8.27	8.29	92.4	331	0.0	--	--
"	"	"	"	6.00	20.59	8.26	8.28	92.2	331	0.0	--	--
"	"	"	"	8.00	20.57	8.25	8.24	91.8	330	0.0	--	--
6	97/06/03	76844	3.00	0.50	17.10	8.34	--	--	337	0.0	--	--
"	"	"	"	1.00	16.87	8.34	--	--	336	0.0	--	--
"	"	"	"	2.00	16.13	8.41	--	--	336	0.2	--	--

Table D-1. On-board physical-chemical measurements of Lake Couchiching waters.

Concentration units as noted: mg/l = ppm; NTU = Nephelometric Turbidity Units.

Station Number	Sample Date	Field Sample Number	Water Depth, m	Sample Depth, m	Temperature degrees C	pH -log[H+]	Oxygen, dissolved mg/l	Oxygen, % saturation	Conductivity umhos/cm@25C	Turbidity NTU	Current Speed cm/sec	Current Direction magnetic North
"	"	"	"	2.40	16.16	8.40	--	--	335	0.4	--	--
"	97/05/28	--	"	2.85	16.13	--	--	--	--	--	2.7	210
"	97/07/08	48613	3.00	0.50	20.45	8.25	8.46	94.0	330	0.0	--	--
"	"	"	"	1.00	20.43	8.27	8.43	93.7	330	0.0	--	--
"	"	"	"	2.00	20.44	8.28	8.43	93.7	330	0.0	--	--
"	"	"	"	2.50	20.44	8.28	8.43	93.7	329	0.0	--	--
7	97/06/03	76845	2.20	0.40	16.92	8.47	--	--	328	0.0	--	--
"	"	"	"	1.10	17.15	8.45	--	--	330	0.0	--	--
"	"	"	"	1.60	17.01	8.46	--	--	329	0.0	--	--
"	97/05/29	--	"	2.05	14.80	--	--	--	--	--	3.6	135
"	97/07/08	48612	2.20	0.40	20.01	8.20	7.93	87.3	328	0.0	--	--
"	"	"	"	1.50	20.02	8.18	7.87	86.7	329	0.1	--	--
8	97/06/03	76848	1.30	0.60	17.34	8.27	--	--	329	0.1	--	--
"	"	"	"	0.90	17.30	8.39	--	--	329	0.0	--	--
"	97/05/29	--	"	1.15	15.20	--	--	--	--	--	7.1	105
"	97/07/07	48607	1.40	0.20	22.13	8.68	11.46	131.6	297	0.0	--	--
"	"	"	"	1.20	22.15	8.72	11.29	129.7	297	0.0	--	--
9	97/06/03	76849	2.00	0.50	16.59	8.53	--	--	331	0.0	--	--
"	"	"	"	1.00	16.67	8.43	--	--	332	0.0	--	--
"	"	"	"	1.50	16.47	8.45	--	--	331	0.0	--	--
"	97/05/29	--	"	1.85	15.02	--	--	--	--	--	0.8	67
"	97/07/07	48606	2.20	0.60	22.01	8.37	8.88	101.7	324	0.0	--	--
"	"	"	"	1.50	22.00	8.44	8.97	102.7	323	0.0	--	--
10	97/06/03	76850	1.70	0.60	16.75	8.40	--	--	334	0.0	--	--
"	"	"	"	1.00	16.66	8.33	--	--	334	0.0	--	--
"	--	--	"	1.55	--	--	--	--	--	--	--	--
"	97/07/07	48605	1.60	0.20	21.94	8.42	8.83	101.0	324	0.0	--	--
"	"	"	"	1.10	21.95	8.40	8.78	100.4	324	0.0	--	--
11	97/06/03	76851	1.90	0.50	17.62	8.48	--	--	329	0.0	--	--
"	"	"	"	0.90	17.60	8.35	--	--	328	0.3	--	--
"	"	"	"	1.40	17.37	8.36	--	--	328	0.0	--	--
"	--	--	"	1.75	--	--	--	--	--	--	--	--
"	97/07/07	48604	1.90	0.20	21.90	8.60	10.23	116.9	315	0.3	--	--
"	"	"	"	1.10	21.92	8.64	9.91	113.3	315	0.0	--	--
"	"	"	"	1.50	21.93	8.66	10.15	116.1	315	0.0	--	--
12	97/06/03	76852	1.50	0.50	16.64	8.47	--	--	330	0.0	--	--
"	"	"	"	1.00	16.60	8.42	--	--	329	0.0	--	--
"	--	--	"	1.35	--	--	--	--	--	--	--	--
"	97/07/07	48602	1.40	0.40	22.04	8.43	9.47	108.5	317	0.7	--	--
"	"	"	"	1.00	22.05	8.48	9.46	108.4	317	0.7	--	--
13	97/06/03	76853	1.70	0.50	15.74	8.48	--	--	331	0.0	--	--
"	"	"	"	1.00	15.70	8.45	--	--	331	0.0	--	--
"	--	--	"	1.55	--	--	--	--	--	--	--	--
"	97/07/07	48603	1.70	0.50	21.87	8.39	9.12	104.1	322	0.0	--	--
"	"	"	"	1.30	21.88	8.39	9.02	103.1	322	0.0	--	--
14	97/06/03	76854	3.00	0.50	15.15	8.49	--	--	333	0.7	--	--
"	"	"	"	1.00	14.96	8.50	--	--	333	0.6	--	--

Table D-1. On-board physical-chemical measurements of Lake Couchiching waters.

Concentration units as noted: mg/l = ppm; NTU = Nephelometric Turbidity Units.

Station Number	Sample Date	Field Sample Number	Water Depth, m	Sample Depth, m	Temperature degrees C	pH -log[H+]	Oxygen, dissolved mg/l	Oxygen, % saturation	Conductivity umhos/cm@25C	Turbidity NTU	Current Speed cm/sec	Current Direction magnetic North
"	"	"	"	2.00	14.50	8.51	--	--	332	0.9	--	--
"	"	"	"	2.50	14.24	8.51	--	--	333	0.8	--	--
"	97/06/02	--	"	2.85	14.85	--	--	--	--	--	0.2	141
"	97/07/08	48608	2.90	0.60	21.01	8.35	8.72	97.9	321	0.0	--	--
"	"	"	"	1.00	20.92	8.37	8.58	96.2	322	0.0	--	--
"	"	"	"	2.00	20.65	8.35	8.40	93.7	323	0.0	--	--
"	"	"	"	2.50	20.57	8.36	8.45	94.1	322	0.0	--	--
15	97/06/03	76855-DC	9.70	0.50	15.89	8.46	--	--	334	2.0	--	--
"	"	"	"	1.60	15.80	8.46	--	--	334	2.2	--	--
"	"	"	"	3.00	15.44	8.47	--	--	333	2.6	--	--
"	"	"	"	4.00	15.12	8.50	--	--	333	2.8	--	--
"	"	"	"	5.00	14.87	8.50	--	--	334	2.9	--	--
"	"	"	"	6.00	14.47	8.50	--	--	335	2.9	--	--
"	"	"	"	7.00	13.24	8.45	--	--	334	2.8	--	--
"	"	"	"	8.00	12.95	8.42	--	--	335	2.6	--	--
"	"	"	"	9.00	12.41	8.34	--	--	335	1.9		
"	97/06/02	--	"	9.55	14.52	--	--	--	--	--	0.0	180
"	97/07/08	48610-DC	9.60	0.50	21.03	8.35	8.27	93.0	326	0.1	--	--
"	"	"	"	2.00	21.04	8.34	8.28	93.0	326	0.0	--	--
"	"	"	"	4.00	21.03	8.35	8.26	92.8	326	0.0	--	--
"	"	"	"	6.00	21.04	8.34	8.26	92.8	326	0.0	--	--
"	"	"	"	8.00	21.03	8.33	8.26	92.8	326	0.0	--	--
"	"	"	"	9.00	21.03	8.34	8.26	92.8	326	0.1	--	--
16	97/06/03	76856	1.50	0.60	16.89	8.34	--	--	339	0.6	--	--
"	"	"	"	1.00	16.90	8.27	--	--	339	0.0	--	--
"	97/06/02	--	"	1.35	19.26	--	--	--	--	--	0.0	259
"	97/07/08	48611	1.30	0.50	20.31	8.27	8.94	99.1	326	0.0	--	--
"	"	"	"	1.00	20.31	8.32	9.13	101.2	326	0.0	--	--
17	97/06/03	76857	7.00	0.50	15.64	8.50	--	--	339	0.0	--	--
"	"	"	"	1.00	15.57	8.43	--	--	339	0.0	--	--
"	"	"	"	2.00	15.54	8.40	--	--	339	0.0	--	--
"	"	"	"	3.00	14.60	8.43	--	--	337	0.0	--	--
"	"	"	"	4.00	14.29	8.43	--	--	336	0.0	--	--
"	"	"	"	5.00	13.46	8.37	--	--	338	0.1	--	--
"	"	"	"	6.00	13.13	8.28	--	--	340	0.8	--	--
"	97/06/02	--	"	6.85	14.00	--	--	--	--	--	0.0	340
"	97/07/08	48624	7.00	0.40	20.45	8.24	8.52	94.6	331	0.2	--	--
"	"	"	"	1.90	20.45	8.30	8.51	94.6	331	0.1	--	--
"	"	"	"	4.00	20.45	8.30	8.51	94.5	331	0.1	--	--
"	"	"	"	6.00	20.45	8.29	8.50	94.5	331	0.5	--	--
18	97/06/03	76859	1.20	0.50	16.58	8.49	--	--	340	3.5	--	--
"	97/05/29	--	"	1.05	15.63	--	--	--	--	--	0.0	195
"	97/07/08	48622	1.30	0.30	19.22	8.59	9.66	104.7	327	0.0	--	--
"	"	"	"	0.80	19.22	8.42	9.64	104.5	327	0.0	--	--
19	97/06/03	76860	1.70	0.60	15.00	8.46	--	--	339	0.4	--	--
"	"	"	"	1.00	15.03	8.45	--	--	339	0.4	--	--
"	97/05/29	--	"	1.55	12.87	--	--	--	--	--	0.0	--

Table D-1. On-board physical-chemical measurements of Lake Couchiching waters.

Concentration units as noted: mg/l = ppm; NTU = Nephelometric Turbidity Units.

Station Number	Sample Date	Field Sample Number	Water Depth, m	Sample Depth, m	Temperature degrees C		pH -log[H+]		Oxygen, dissolved mg/l		Oxygen, % saturation		Conductivity umhos/cm@25C		Turbidity NTU		Current Speed cm/sec	Current Direction magnetic North
"	97/07/08	48621	1.80	0.50	19.41		8.38		9.06		98.7		335		0.0		--	--
"	"	"	"	1.50	19.43		8.44		9.12		99.3		336		0.0		--	--
20	97/06/03	76843	2.10	0.50	15.57		8.51		--		--		336		0.0		--	--
"	"	"	"	1.00	15.65		8.49		--		--		335		0.0		--	--
"	"	"	"	1.50	15.44		8.50		--		--		334		0.0		--	--
"	97/05/29	--	"	1.95	13.67		--		--		--		--		--		0.0	--
"	97/07/08	48620	2.00	0.50	19.86		8.24		8.48		93.1		327		0.0		--	--
"	"	"	"	1.50	19.85		8.27		8.57		94.0		327		0.0		--	--
21	97/06/03	76846	2.50	0.30	16.54		8.39		--		--		336		0.0		--	--
"	"	"	"	1.00	16.31		8.35		--		--		335		0.0		--	--
"	"	"	"	2.00	15.56		8.41		--		--		333		0.0		--	--
"	97/06/02	--	"	2.35	17.20		--		--		--		--		--		0.0	172
"	97/07/07	48601	2.20	0.40	21.22		8.29		8.69		98.1		329		0.9		--	--
"	"	"	"	1.60	21.22		8.27		8.49		95.7		329		1.6		--	--
Mean & Std. Dev'n.,	97/06/03				15.93	+/-0.86	8.44	+/-0.07	9.28	+/-2.78	92.8	+/-28.1	335	+/-3.8	1.68	+/-2.21	--	--
Mean & Std. Dev'n.,	97/07/07-08				20.76	+/-0.83	8.34	+/-0.14	8.77	+/-0.77	98.1	+/-9.6	326	+/-7.6	0.12	+/-0.30	--	--
PWQO:					--		6.5-8.5		4@20C-7@0C		47-48		--		--		--	--
IPWQO:					--		--		--		--		--		--		--	--

NOTES: blank or "--" indicates that data is not available for this parameter or sample.

Dissolved Oxygen guideline range is for warmwater fishes.

TABLE D-2 . Current speed, direction and temperature of Lake Couchiching waters (June 4-6 measurements, using Mini-Aanderaa meters).

Station Number SWS	Sample Date	Water Depth, m	Meter Depth, m	Current Speed cm/sec Vector Mean	Current Speed cm/sec Mean *	Current Speed cm/sec Min.	Current Speed cm/sec Max.	Current Speed cm/sec n	Current Speed cm/sec Std. Dev'n. *	Current Speed cm/sec % Coeff Var'n.	Current Heading degrees from magnetic North Vector Mean	Current Heading degrees from magnetic North Min.	Current Heading degrees from magnetic North Max.	Current Heading degrees from magnetic North n	Temperature degrees C Mean *	Temperature degrees C Min.	Temperature degrees C Max.	Temperature degrees C Std. Dev'n. *	Temperature degrees C n	Temperature degrees C % Coeff Var'n.
C1	97/06/04	3.9	1.0	1.3	3.7	2.4	5.0	21	0.8	22	263	0	330	21	18.90	18.35	19.37	0.28	21	1.5
"	"	"	2.9	3.8	5.4	3.3	7.5	21	1.2	22	341	0	345	21	18.11	17.60	18.93	0.33	21	1.8
C2	97/06/04	2.9	1.4	2.8	3.0	2.4	4.1	20	0.5	17	346	0	345	20	19.04	18.94	19.20	0.09	17	0.5
C3	97/06/04	2.9	1.4	3.2	3.9	2.4	5.0	19	0.7	18	327	0	345	29	19.39	19.09	19.77	0.24	18	1.2
C4	97/06/04	2.7	1.2	2.6	5.9	3.3	9.2	18	1.9	32	87	0	240	18	20.61	20.19	20.82	0.20	17	1.0
C5	97/06/04	3.7	2.2	3.4	3.5	2.4	4.5	15	0.7	20	19	0	30	15	19.08	18.77	19.84	0.28	13	1.5
C6	97/06/04	8.2	1.5	5.3	9.4	7.1	11.3	21	1.1	12	97	45	345	21	19.30	18.97	19.96	0.24	18	1.2
"	"	"	6.7	0.8	5.2	3.3	6.2	21	0.8	15	38	0	330	21	14.44	14.20	14.96	0.26	17	1.8
C7	97/06/04	2.7	1.2	2.1	3.9	0.0	5.4	11	1.4	36	151	90	270	11	18.99	18.85	19.05	0.08	6	0.4
C8	97/06/04	2.9	1.4	8.3	11.2	7.5	12.6	10	1.8	16	78	30	255	10	19.72	19.56	19.82	0.10	5	0.5
C9	97/06/04-05	9.7	2.0	0.2	0.2	0.0	2.8	123	0.7	350	316	0	345	123	16.97	16.70	17.85	0.27	118	1.6
"	"	"	7.7	1.9	4.7	0.0	9.2	124	2.6	55	212	30	255	124	13.84	13.18	14.51	0.37	119	2.7
"	97/06/05-06	9.0	2.0	0.3	0.5	0.0	4.5	133	1.1	220	102	0	345	133	17.74	17.33	18.44	0.25	128	1.4
"	"	"	7.0	S	0.0	0.0	0.0	133	–	–	S	0	345	133	13.96	13.41	14.69	0.36	130	2.6
C10	97/06/04-05	9.0	2.0	0.3	0.3	0.0	4.1	113	1.0	333	63	30	180	113	16.89	16.65	17.90	0.26	108	1.5
"	"	"	7.0	0.2	0.3	0.0	5.0	114	1.0	333	85	0	345	114	15.00	14.33	16.99	0.70	114	4.7
C11	97/06/04	7.0	1.5	0.7	2.0	0.0	5.4	12	1.7	85	321	15	345	12	19.34	18.92	19.74	0.27	11	1.4
"	"	"	5.5	0.2	1.3	0.0	6.2	12	2.1	162	250	60	255	12	15.50	15.33	15.84	0.15	9	1.0
C12	97/06/05	7.0	1.5	0.7	1.5	0.0	3.7	10	1.6	107	328	150	345	10	19.27	19.09	19.43	0.13	9	0.7
"	"	"	5.5	S	0.0	0.0	0.0	9	–	–	S	0	345	9	16.61	16.45	16.82	0.14	8	0.8
C13	97/06/05	3.3	1.8	1.1	1.3	0.0	5.0	8	2.0	154	27	15	345	8	19.73	19.64	19.81	0.06	6	0.3
C14	97/06/05	3.5	1.5	2.0	2.1	0.0	3.7	7	1.5	71	292	270	315	7	21.28	21.18	21.39	0.08	5	0.1
C15	97/06/05	8.0	1.5	3.7	3.8	3.3	4.1	8	0.4	11	11	0	15	8	19.88	19.84	19.91	0.04	4	0.2
"	"	"	6.5	2.8	3.0	2.4	4.1	8	0.5	17	43	30	75	8	14.90	14.74	15.31	0.21	6	1.4
C16	97/06/05	3.0	1.5	1.3	2.0	0.0	3.3	7	1.4	70	317	60	330	7	20.93	20.41	21.94	0.63	5	3.0
C17	97/06/05	3.2	1.7	1.5	1.9	0.0	4.1	6	1.6	84	311	0	300	6	20.10	19.71	20.54	0.35	4	1.7
C18	97/06/05	3.0	1.5	1.6	3.4	2.4	5.0	14	0.8	24	184	15	330	14	19.90	19.87	19.91	0.02	9	0.1
C19	97/06/05	3.9	2.4	2.1	4.2	2.4	6.2	18	1.4	33	346	0	345	18	19.65	19.34	19.93	0.19	16	1.0
C20	97/06/05	3.2	1.7	1.1	3.6	2.4	6.2	14	1.2	33	330	0	330	14	20.20	20.07	20.57	0.13	12	0.6
C21	97/06/05	2.8	1.3	1.8	2.7	0.0	3.7	8	1.2	44	183	15	240	8	20.68	20.58	20.82	0.08	6	0.4
C22	97/06/05-06	3.2	1.7	0.3	0.4	0.0	6.2	135	1.3	325	341	0	345	135	18.29	17.87	19.67	0.43	133	2.4
C23	97/06/05-06	2.7	1.2	1.1	1.2	0.0	6.2	132	1.9	158	44	0	345	132	19.29	18.38	21.50	0.85	131	4.4
C24	97/06/06	3.0	1.5	0.5	1.5	0.0	3.3	7	1.4	93	198	60	315	7	19.59	19.45	19.86	0.20	6	1.0
C25	97/06/06	3.0	1.5	2.8	3.0	2.4	3.7	10	0.5	17	257	225	300	10	18.78	17.06	20.09	1.48	10	7.9

Table D-3. Macro-ion, nutrient and phenolics concentrations in Lake Couchiching water samples.
Concentration units as noted.

Station Number	Sample Date	Field Sample Number	Conductivity us/cm@25C	pH -log[H+]	Hardness mg/l	Carbon, dissolved Inorganic mg/l	Carbon, dissolved Organic mg/l	Carbon, total Organic mg/l	Carbon, total particulate mg/l	Calcium mg/l	Chloride mg/l	Magnesium mg/l	Potassium mg/l	Sodium mg/l
1	97/06/03	76837	345	8.21	136	26.0	3.9	4.6	0.2 <=W	43.1	26.8	6.78	1.87	15.4
"	97/07/08	48619	337	8.33	133	26.4	4.2	4.8	0.2 <=W	41.6	26.8	7.04	1.85	15.7
2	97/06/03	76838	344	8.30	133	26.6	3.9	4.4	0.2 <=W	42.0	26.8	6.80	1.83	16.1
"	97/07/08	48618	339	8.31	134	26.4	4.2	5.0	0.2 <=W	42.1	26.8	7.00	1.97	15.9
3	97/06/03	76839	345	8.08	136	26.4	3.9	6.2	0.2 <=W	43.4	26.8	6.84	1.84	15.5
"	97/07/08	48617	340	8.30	135	27.0	4.2	4.8	0.2 <=W	42.4	26.6	7.04	1.98	15.9
4	97/06/03	76840	343	8.21	135	26.4	3.8	4.4	0.2 <=W	43.1	26.8	6.74	1.80	15.7
"	97/07/08	48616	340	8.32	135	26.4	4.2	4.8	0.2 <=W	42.2	27.2	7.16	2.01	16.2
5	97/06/03	76841	345	8.27	132	26.6	3.7	5.0	0.2 <=W	41.7	26.6	6.72	1.86	15.5
"	"	76842-DC	345	8.24	126	26.6	3.8	4.6	0.2 <=W	39.6	26.6	6.64	1.85	15.7
"	97/07/08	48614-DC	340	8.33	132	26.8	4.2	7.0	0.8 <T	41.4	26.8	7.00	1.92	15.7
"	"	48615	339	8.31	134	27.2	4.2	5.2	0.2 <=W	42.0	26.8	7.06	2.02	15.8
6	97/06/03	76844	342	8.11	135	26.0	3.7	5.2	0.2 <=W	42.8	26.8	6.72	1.86	15.4
"	97/07/08	48613	339	8.30	132	26.6	4.4	9.0	0.8 <T	41.0	26.8	7.04	1.92	15.9
7	97/06/03	76845	335	8.27	131	25.2	3.8	5.6	0.2 <=W	41.4	27.2	6.68	1.82	15.2
"	97/07/08	48612	337	8.29	131	27.2	4.2	5.2	0.2 <=W	41.0	26.6	6.96	1.91	16.0
8	97/06/03	76848	335	8.26	131	25.4	3.9	4.8	1.6	41.4	26.8	6.64	1.79	15.6
"	97/07/07	48607	305	8.50	112	21.6	4.7	5.2	0.4 <T	33.8	27.2	6.84	1.82	15.2
9	97/06/03	76849	337	8.22	132	25.8	3.8	4.2	0.2 <=W	42.0	27.0	6.56	1.81	15.4
"	97/07/07	48606	330	8.34	127	24.8	4.1	4.4	5.2	39.4	26.8	6.86	1.85	15.1
10	97/06/03	76850	340	8.29	133	25.8	3.8	4.8	0.2 <=W	42.5	27.0	6.60	1.78	15.4
"	97/07/07	48605	330	8.35	126	24.6	4.0	5.2	0.2 <=W	39.2	27.2	6.86	1.84	15.2
11	97/06/03	76851	335	8.24	130	23.6	3.8	4.6	0.2 <=W	41.0	26.8	6.62	1.82	15.7
"	97/07/07	48604	322	8.55	122	23.8	4.4	5.2	0.2 <=W	37.6	26.8	6.80	1.82	15.4
12	97/06/03	76852	336	8.34	129	25.2	3.9	4.2	0.2 <=W	41.0	26.8	6.54	1.79	15.7
"	97/07/07	48602	322	8.36	123	24.2	4.3	5.4	0.2 <=W	38.1	26.8	6.88	1.85	17.4
13	97/06/03	76853	340	8.24	132	25.4	3.8	4.0	0.2 <=W	42.0	26.8	6.62	1.81	15.8
"	97/07/07	48603	329	8.36	124	24.4	4.2	5.4	0.2 <=W	38.5	26.8	6.84	1.84	15.5
14	97/06/03	76854	341	8.28	134	26.2	3.8	4.0	0.2 <=W	42.8	26.8	6.60	1.82	15.7
"	97/07/08	48608-R	330	8.34	128	25.2	4.4	4.8	1.2	39.6	27.0	7.00	1.91	16.0
"	"	48609-R	332	8.31	127	25.4	4.4	4.8	0.2 <=W	39.5	27.0	6.94	1.92	16.0
15	97/06/03	76855-DC	342	8.29	135	25.8	3.8	4.2	0.2 <=W	42.8	26.8	6.74	1.81	16.0
"	97/07/08	48610-DC	335	8.33	129	26.2	4.2	5.6	0.2 <=W	40.3	26.8	6.96	1.94	15.9
16	97/06/03	76856	346	8.24	132	26.6	3.9	4.2	0.2 <=W	41.7	26.8	6.80	1.89	15.8
"	97/07/08	48611	335	8.30	129	26.2	4.4	5.2	0.2 <=W	40.1	27.0	6.98	1.99	15.8
17	97/06/03	76857-R	345	8.37	138	27.0	5.8	5.0	0.2 <=W	44.1	26.6	6.88	1.85	15.5
"	"	76858-R	346	8.31	131	27.2	3.8	4.4	0.2 <=W	41.1	26.6	6.88	1.85	15.7
"	97/07/08	48624	340	8.34	136	26.0	4.0	5.2	0.2 <=W	42.4	26.8	7.24	1.87	15.9
18	97/06/03	76859	348	8.29	136	27.6	4.1	5.0	0.2 <=W	43.2	26.4	6.88	1.87	15.3
"	97/07/08	48622-R	338	8.37	137	26.0	4.4	5.2	0.2 <=W	43.1	26.4	7.14	1.78	15.6
"	"	48623-R	338	8.40	134	26.4	4.4	5.8	0.2 <=W	42.0	26.2	7.16	1.77	15.4
19	97/06/03	76860	347	8.28	134	26.8	3.7	4.6	0.2 <=W	42.6	26.4	6.82	1.85	15.1
"	97/07/08	48621	345	8.42	140	26.6	3.8	4.4	0.2 <=W	44.4	26.8	7.04	1.85	15.7
20	97/06/03	76843	341	8.28	134	26.4	3.9	4.6	0.2 <=W	42.6	26.6	6.76	1.84	15.3
"	97/07/08	48620	337	8.33	132	26.8	4.3	4.6	0.4 <T	41.3	26.8	7.04	1.89	15.9
21	97/06/03	76846-R	340	8.34	134	26.4	3.7	5.6	0.2 <=W	42.7	26.8	6.64	1.80	15.4

Table D-3. Macro-ion, nutrient and phenolics concentrations in Lake Couchiching water samples.
Concentration units as noted.

Station Number	Sample Date	Field Sample Number	Conductivity us/cm@25C	pH -log[H+]	Hardness mg/l	Carbon, dissolved Inorganic mg/l	Carbon, dissolved Organic mg/l	Carbon, total Organic mg/l	Carbon, total particulate mg/l	Calcium mg/l	Chloride mg/l	Magnesium mg/l	Potassium mg/l	Sodium mg/l
"	"	76847-R	341	8.24	134	26.4	3.8	4.8	0.2 <=W	42.8	27.2	6.68	1.79	15.6
"	97/07/07	48601	335	8.30	130	26.0	4.3	6.0	0.2 <=W	40.6	26.6	6.96	1.86	17.3
Mean & Std. Dev'n. 97/06/03			342 +/-4.0	8.26 +/-0.06	133 +/-2.6	26.2 +/-0.6	3.8 +/-0.1	4.7 +/-0.5	0.2 <=W	42.2 +/-1.0	26.8 +/-0.2	6.72 +/-0.10	1.83 +/-0.03	15.6 +/-0.2
Mean & Std. Dev'n. 97/07/07-08			334 +/-8.4	8.35 +/-0.06	130 +/-6.0	25.8 +/-1.3	4.3 +/-0.2	5.3 +/-1.0	0.3 +/-1.1	40.6 +/-2.2	26.8 +/-0.2	6.99 +/-0.11	1.89 +/-0.07	15.8 +/-0.5
19	97/06/03	76861-SB	7	6.63	1.8	0.6 <T	0.1 <=W	0.2 <=W	0.8 <T	0.65	0.2 <=W	0.04 <T	0.01 <=W	0.28
"	"	76862-TB	2 <T	6.01	0.2 <=W	0.6 <T	0.1 <=W	0.2 <=W	0.6 <T	0.05 <=W	0.2 <=W	0.02 <=W	0.02 <T	0.32
17	97/07/08	48625-SB	3 <T	6.43	0.2 <=W	0.2 <=W	0.1 <=W	0.2 <=W	0.2 <=W	0.05 <=W	0.2 <=W	0.02 <=W	0.01 <=W	0.08 <T
"	"	48626-TB	2 <T	6.10	0.2 <=W	0.2 <=W	0.1 <=W	0.4 <T	0.2 <=W	0.05 <=W	0.2 <=W	0.02 <=W	0.01 <=W	0.08 <T
PWQO:			--	6.5-8.5	--	--	--	--	--	--	--	--	--	--
IPWQO:			--	--	--	--	--	--	--	--	--	--	--	--

NOTES: "<MDL" = less than method detection limit.
" <=W " = no measurable response (zero): less than reported value.
"-R " = field temporal replicate.
"- DC " = Depth Composite.
"-SB " = System Blank.
" -TB " = Travel Blank.

Table D-3. Macro-ion, nutrient and phenolics concentrations in Lake Couchiching water samples.
Concentration units as noted.

Station Number	Sample Date	Field Sample Number	Sulphate mg/l	Nitrogen, NH_3+NH_4 mg/l		Nitrogen, NO_2 mg/l		Nitrogen, NO_2+NO_3 mg/l		Nitrogen, TKN mg/l	Phosphorus, PO_4 mg/l		Phosphorus, total mg/l		Silicon, reactive mg/l	Phenolics, 4AAP ug/l	
1	97/06/03	76837	17.5	0.012		0.001	<=W	0.005	<=W	0.36	0.0005	<=W	0.006	<T	0.56	0.2	<=W
"	97/07/08	48619	17.0	0.018		0.005		0.015	<T	0.44	0.0005	<=W	0.012		1.46	0.8	<T
2	97/06/03	76838	17.5	0.002	<=W	0.001	<=W	0.005	<=W	0.36	0.0005	<=W	0.006	<T	0.58	0.2	<=W
"	97/07/08	48618	17.0	0.030		0.003	<T	0.010	<T	0.42	0.0005	<=W	0.016		1.44	0.4	<T
3	97/06/03	76839	18.0	0.008	<T	0.001	<=W	0.005	<=W	0.44	0.0005	<=W	0.006	<T	0.56	0.2	<=W
"	97/07/08	48617	17.0	0.022		0.004	<T	0.015	<T	0.44	0.0005	<=W	0.014		1.46	0.2	<=W
4	97/06/03	76840	17.5	0.008	<T	0.001	<=W	0.005	<=W	0.36	0.0005	<=W	0.006	<T	0.56	0.2	<=W
"	97/07/08	48616	16.5	0.028		0.007		0.015	<T	0.42	0.0005	<=W	0.010		1.40	0.4	<T
5	97/06/03	76841	18.0	0.008	<T	0.001	<=W	0.010	<T	0.40	0.0005	<=W	0.008	<T	0.76	—	
"	"	76842-DC	17.5	0.002	<=W	0.001	<=W	0.005	<=W	0.44	0.0005	<=W	0.008	<T	0.72	0.2	<=W
"	97/07/08	48614-DC	17.0	0.028		0.005		0.010	<T	0.44	0.0005	<=W	0.012		1.46	0.4	<T
"	"	48615	17.0	0.024		0.003	<T	0.010	<T	0.44	0.0005	<=W	0.010		1.46	0.2	<=W
6	97/06/03	76844	18.0	0.010		0.001	<=W	0.005	<=W	0.50	0.0005	<=W	0.008	<T	0.48	0.2	<=W
"	97/07/08	48613	16.5	0.018		0.003	<T	0.010	<T	0.44	0.0005	<=W	0.016		1.42	0.2	<T
7	97/06/03	76845	17.5	0.006	<T	0.001	<=W	0.005	<=W	0.34	0.0010	<T	0.004	<T	0.34	0.2	<=W
"	97/07/08	48612	16.5	0.022		0.004	<T	0.010	<T	0.42	0.0005	<=W	0.010		1.16	0.4	<T
8	97/06/03	76848	17.0	0.008	<T	0.001	<=W	0.005	<=W	0.34	0.0015	<T	0.006	<T	0.36	0.2	<=W
"	97/07/07	48607	16.0	0.018		0.001	<=W	0.025		0.48	0.0020	<T	0.010		1.04	0.4	<T
9	97/06/03	76849	17.5	0.006	<T	0.001	<=W	0.005	<=W	0.32	0.0010	<T	0.006	<T	0.44	0.2	<=W
"	97/07/07	48606	16.5	0.010		0.001	<=W	0.025		0.40	0.0020	<T	0.008	<T	0.94	0.4	<T
10	97/06/03	76850	17.5	0.010		0.001	<=W	0.005	<=W	0.32	0.0005	<=W	0.004	<T	0.46	0.2	<=W
"	97/07/07	48605	16.0	0.024		0.001	<=W	0.025		0.40	0.0020	<T	0.008	<T	0.94	0.4	<T
11	97/06/03	76851	17.5	0.010		0.001	<=W	0.005	<=W	0.34	0.0005	<=W	0.004	<T	0.38	0.2	<=W
"	97/07/07	48604	16.0	0.014		0.001	<=W	0.025		0.42	0.0020	<T	0.008	<T	1.00	0.2	<T
12	97/06/03	76852	17.5	0.010		0.001	<=W	0.005	<=W	0.36	0.0005	<=W	0.006	<T	0.44	0.2	<=W
"	97/07/07	48602	16.0	0.018		0.001	<=W	0.020	<T	0.42	0.0025		0.008	<T	1.06	0.4	<T
13	97/06/03	76853	17.5	0.010		0.001	<=W	0.005	<=W	0.34	0.0005	<=W	0.006	<T	0.50	0.2	<=W
"	97/07/07	48603	16.0	0.008	<T	0.001	<=W	0.025		0.40	0.0020	<T	0.008	<T	1.00	0.4	<T
14	97/06/03	76854	17.5	0.002	<=W	0.001	<=W	0.005	<=W	0.32	0.0005	<=W	0.006	<T	0.50	0.2	<=W
"	97/07/08	48608-R	16.5	0.018		0.002	<T	0.010	<T	0.40	0.0005	<=W	0.010		0.96	0.8	<T
"	"	48609-R	16.5	0.022		0.003	<T	0.010	<T	0.42	0.0005	<=W	0.010		0.96	0.4	<T
15	97/06/03	76855-DC	17.5	0.008	<T	0.001	<=W	0.005	<=W	0.36	0.0005	<=W	0.006	<T	0.50	0.2	<=W
"	97/07/08	48610-DC	16.5	0.018		0.002	<T	0.010	<T	0.42	0.0005	<=W	0.010		0.98	0.6	<T
16	97/06/03	76856	17.5	0.014		0.001	<=W	0.005	<=W	0.38	0.0005	<=W	0.006	<T	0.66	0.4	<T
"	97/07/08	48611	16.5	0.010		0.002	<T	0.005	<=W	0.42	0.0005	<=W	0.010		1.34	0.2	<T
17	97/06/03	76857-R	18.0	0.008	<T	0.001	<=W	0.005	<=W	0.34	0.0005	<=W	0.006	<T	0.76	0.2	<=W
"	"	76858-R	17.5	0.010		0.001	<=W	0.005	<=W	0.34	0.0005	<=W	0.006	<T	0.76	0.2	<=W
"	97/07/08	48624	17.0	0.018		0.002	<T	0.015	<T	0.42	0.0005	<=W	0.012		1.48	0.6	<T
18	97/06/03	76859	17.5	0.018		0.001	<=W	0.005	<=W	0.42	0.0005	<=W	0.016		0.90	0.2	<=W
"	97/07/08	48622-R	17.0	0.004	<T	0.002	<T	0.010	<T	0.44	0.0005	<=W	0.012		1.18	0.6	<T
"	"	48623-R	16.5	0.008	<T	0.002	<T	0.010	<T	0.42	0.0005	<=W	0.012		1.16	0.4	<T
19	97/06/03	76860	18.5	0.014		0.002	<T	0.025		0.32	0.0005	<=W	0.008	<T	1.08	0.2	<=W
"	97/07/08	48621	17.0	0.018		0.002	<T	0.015	<T	0.40	0.0005	<=W	0.012		1.12	0.4	<T
20	97/06/03	76843	17.5	0.012		0.001	<=W	0.005	<=W	0.36	0.0005	<=W	0.006	<T	0.60	0.2	<=W
"	97/07/08	48620	16.5	0.014		0.001	<=W	0.010	<T	0.44	0.0005	<=W	0.010		1.46	0.8	<T
21	97/06/03	76846-R	18.0	0.010		0.001	<=W	0.005	<=W	0.32	0.0010	<T	0.004	<T	0.48	0.2	<=W

Table D-3. Macro-ion, nutrient and phenolics concentrations in Lake Couchiching water samples.
Concentration units as noted.

Station Number	Sample Date	Field Sample Number	Sulphate mg/l	Nitrogen, NH_3+NH_4 mg/l	Nitrogen, NO_2 mg/l	Nitrogen, NO_3+NO_2 mg/l	Nitrogen, TKN mg/l	Phosphorus, PO_4 mg/l	Phosphorus, total mg/l	Silicon, reactive mg/l	Phenolics, 4AAP ug/l
"	"	76647-R	18.0	0.008 <T	0.001 <=W	0.005 <=W	0.32	0.0010 <T	0.006 <T	0.46	0.2 <=W
"	97/07/07	48601	16.0	0.016	0.001 <=W	0.025	0.42	0.0025	0.010	1.26	0.2 <=W
Mean & Std. Dev'n. 97/06/03			17.6 +/-0.3	0.009 +/-0.004	0.002 +/-0.002	0.006 +/-0.004	0.36 +/-0.05	0.0005 <=W	0.006 +/-0.002	0.58 +/-0.18	0.2 <=W
Mean & Std. Dev'n. 97/07/07-08			16.5 +/-0.4	0.018 +/-0.007	0.001 <=W	0.015 +/-0.007	0.42 +/-0.02	0.0006 +/-0.0010	0.011 +/-0.002	1.21 +/-0.21	0.4 +/-0.2
19	97/06/03	76861-SB	2.5 <T	0.002 <=W	0.001 <=W	0.005 <=W	0.02 <=W	0.0005 <=W	0.002 <=W	0.02 <=W	0.4 <T
"	"	76862-TB	2.5 <T	0.004 <T	0.001 <=W	0.005 <=W	0.02 <=W	0.0005 <=W	0.002 <=W	0.02 <=W	0.2 <=W
17	97/07/08	48625-SB	5.0	0.002 <=W	0.001 <=W	0.010 <T	0.02 <=W	0.0005 <=W	0.002 <=W	0.02 <=W	0.4 <T
"	"	48626-TB	5.0	0.002 <=W	0.001 <=W	0.010 <T	0.02 <=W	0.0005 <=W	0.002 <=W	0.02 <=W	--
PWQO:			--	0.020	--	--	--	--	--	--	1
IPWQO:			--	--	--	--	--	--	0.020	--	--

NOTES: "<MDL" = less than method detection limit.
" <=W " = no measurable response (zero): less than reported value.
"-R " = field temporal replicate.
"- DC " = Depth Composite.
"-SB " = System Blank.
" -TB " = Travel Blank.

Table D-4. Physical factors, chlorophyll and bacterial concentrations in Lake Couchiching water samples in June and July 1997.
Concentration units as noted: mg/l = ppm; ug/l = ppb; counts/dl = counts/100 ml; TCU = total colourimetric units; FTU = Formazin colourimetric units..

Station Number	Sample Date	Field Sample Number	Water Depth, m	Sample Depth, m	Secchi Depth, m	Colour, true TCU	Turbidity FTU	Suspended Solids, mg/l	Chlorophyll a, total ug/l	Chlorophyll b, total ug/l	Chlorophyll a, corrected ug/l	*Escherichia coli* counts/dl	Fecal *Streptococcus* counts/dl	*Pseudomonas aeruginosa* counts/dl
1	97/06/03	76837	1.9	1.0	1.9	4.6	0.83	1.0 <=W	2.6	0.3 <T	2.0 <T	36	18	0
"	97/07/08	48619	1.9	1.0	1.9	4.8	0.56	1.0 <T	1.0	0.1 <=W	1.0 <=W	4	2 <	0
2	97/06/03	76838	2.7	1.0	2.7	4.6	0.68	1.0 <=W	1.6	0.2 <T	1.0 <=W	2 <	2 <	0
"	97/07/08	48618	2.8	1.0	2.8	4.4	0.60	1.0 <T	1.0	0.1 <=W	1.0 <=W	2 <	2 <	0
3	97/06/03	76839	2.8	1.0	2.8	4.2	0.59	1.0 <=W	1.4	0.2 <T	1.0 <=W	2 <	8	0
"	97/07/08	48617	2.5	1.0	2.5	4.6	0.87	1.0 <T	0.2 <T	0.2 <T	1.0 <=W	2 <	2	0
4	97/06/03	76840	2.0	1.0	2.0	4.0	1.64	1.0 <T	0.8 <T	0.2 <T	1.0 <=W	2 <	2 <	0
"	97/07/08	48616	2.0	1.0	2.0	4.6	0.52	1.0 <T	0.8 <T	0.1 <=W	1.0 <=W	2	10	0
5	97/06/03	76841	9.2	1.0	5.5	4.4	0.65	1.0 <=W	1.4	0.2 <T	1.0 <=W	—	—	—
"	"	76842-DC	9.2	0.0-8.0	5.5	4.6	0.65	2.0 <T	2.0	0.3 <T	2.0 <T	2 <	2 <	0
"	97/07/08	48614-DC	9.0	0.0-8.0	5.5	4.4	0.87	1.0 <T	1.0	0.1 <=W	1.0 <=W	2 <	2 <	0
"	"	48615	9.0	8.0	5.5	4.2	1.00	1.0 <T	—	—	—	—	—	—
6	97/06/03	76844	3.0	1.0	3.0	4.2	0.96	1.0 <=W	1.2	0.2 <T	1.0 <=W	2 <	2 <	0
"	97/07/08	48613	3.0	1.0	3.0	5.2	0.70 524	1.0 <T	0.8 <T	0.2 <T	1.0 <=W	2	2 <	0
7	97/06/03	76845	2.2	1.0	2.2	3.8	0.64	1.0 <=W	0.6 <T	0.1 <=W	1.0 <=W	2 <	2 <	0
"	97/07/08	48612	2.2	1.0	2.2	4.4	1.04	1.5 <T	1.0	0.2 <T	1.0 <=W	2 <	2 <	0
8	97/06/03	76848	1.3	0.9	1.3	3.8	0.92	1.0 <=W	1.2	0.2 <T	1.0 <=W	2 <	2 <	0
"	97/07/07	48607	1.4	1.0	1.4	4.2	0.78	1.0 <T	0.4 <T	0.1 <=W	1.0 <=W	2 <	2 <	0
9	97/06/03	76849	2.0	1.0	2.0	3.6	0.80	1.0 <=W	1.4	0.2 <T	1.0 <=W	2 <	2 <	0
"	97/07/07	48606	2.2	1.0	2.2	4.2	0.73	1.0 <T	1.2	0.2 <T	1.0 <=W	2 <	2 <	0
10	97/06/03	76850	1.7	1.0	1.7	4.0	0.62	1.0 <=W	0.6 <T	0.1 <=W	1.0 <=W	2 <	2	0
"	97/07/07	48605	1.6	1.0	1.6	3.6	0.67	1.0 <T	1.2	0.1 <=W	1.0 <=W	2 <	2 <	0
11	97/06/03	76851	1.9	1.0	1.9	3.8	1.12	1.0 <=W	0.8 <T	0.2 <T	1.0 <=W	2 <	2 <	0
"	97/07/07	48604	1.9	1.0	1.9	4.0	0.73	1.0 <T	0.6 <T	0.1 <=W	1.0 <=W	2 <	2	0
12	97/06/03	76852	1.5	1.0	1.5	4.2	0.91	1.0 <=W	1.2	0.2 <T	1.0 <=W	2 <	2 <	0
"	97/07/07	48602	1.4	1.0	1.4	3.4	0.95	1.0 <T	0.6 <T	0.2 <T	1.0 <=W	2 <	2	0
13	97/06/03	76853	1.7	1.0	1.7	4.2	0.93	3.0 <T	2.0	0.4 <T	2.0 <T	2 <	2 <	0
"	97/07/07	48603	1.7	1.0	1.7	3.6	0.77	1.0 <T	0.6 <T	0.1 <=W	1.0 <=W	2 <	2 <	0
14	97/06/03	76854	3.0	1.0	3.0	4.0	0.93	2.0 <T	2.0	0.3 <T	1.0 <=W	2 <	2	0
"	97/07/08	48608-R	2.9	1.0	2.9	4.2	0.49	1.0 <T	0.6 <T	0.1 <=W	1.0 <=W	2 <	4	0
"	"	48609-R	2.9	1.0	2.9	4.6	0.52	1.0 <T	0.6 <T	0.2 <T	1.0 <=W	2 <	2	0
15	97/06/03	76855-DC	9.7	0.0-9.0	5.0	4.2	0.87	2.0 <T	2.4	0.4 <T	2.0 <T	2 <	2 <	0
"	97/07/08	48610-DC	9.6	0.0-8.5	5.0	3.8	0.89	1.0 <T	1.6	0.2 <T	1.0 <=W	2	2	0
	97/06/03	76856	1.5	1.0	1.5	4.4	0.77 524	1.0 <=W	1.0	0.2 <T	1.0 <=W	2 <	2 <	0
"	97/07/08	48611	1.3	1.0	1.3	4.4	0.49	0.5 <T	0.8 <T	0.2 <T	1.0 <=W	2 <	2 <	0
17	97/06/03	76857-R	7.0	1.0	5.0	4.0	0.67	1.0 <=W	1.6	0.2 <T	1.0 <=W	2 <	2 <	0
"	"	76858-R	7.1	1.0	5.0	4.2	0.75	1.0 <=W	1.4	0.2 <T	1.0 <=W	2 <	2 <	0
"	97/07/08	48624	7.0	1.0	5.0	4.4	1.13	1.5 <T	1.2	0.2 <T	1.0 <=W	2 <	2	0
18	97/06/03	76859	1.2	1.0	1.2	6.0	1.03	2.0 <T	1.6	0.2 <T	1.0 <=W	2 <	2 <	0
"	97/07/08	48622-R	1.3	1.0	1.3	7.8	0.70	1.0 <T	1.0	0.2 <T	1.0 <=W	2 <	4	0
"	"	48623-R	1.3	1.0	1.3	8.2	0.61	1.0 <T	1.0	0.2 <T	1.0 <=W	2 <	40	0
19	97/06/03	76860	1.7	1.0	1.7	4.8	0.55	1.0 <=W	0.6 <T	0.2 <T	1.0 <=W	2 <	2 <	0
"	97/07/08	48621	1.8	1.0	1.8	4.4	0.46	0.5 <T	0.8 <T	0.1 <=W	1.0 <=W	2	2 <	0
20	97/06/03	76843	2.1	1.0	2.1	4.4	0.65	1.0 <=W	1.6	0.2 <T	1.0 <=W	2 <	2 <	0
"	97/07/08	48620	2.0	1.0	2.0	4.8	0.54	0.5 <T	0.4 <T	0.1 <=W	1.0 <=W	2 <	2 <	0
21	97/06/03	76846-R	2.5	1.0	2.5	3.6	0.74	1.0 <=W	1.8	0.4 <T	1.0 <=W	2 <	2 <	0

Table D-4. Physical factors, chlorophyll and bacterial concentrations in Lake Couchiching water samples in June and July 1997.
Concentration units as noted: mg/l = ppm; ug/l = ppb; counts/dl = counts/100 ml; TCU = total colourimetric units; FTU = Formazin colourimetric units..

Station Number	Sample Date	Field Sample Number	Water Depth, m	Sample Depth, m	Secchi Depth, m	Colour, true TCU	Turbidity FTU	Suspended Solids, mg/l	Chlorophyll a, total ug/l	Chlorophyll b, total ug/l	Chlorophyll a, corrected ug/l	*Eschericia coli* counts/dl	Fecal *Streptococcus* counts/dl	*Pseudomonas aeruginosa* counts/dl
"	"	76847-R	2.5	1.0	2.5	3.4	0.90	1.0 <=W	1.8	0.3 <T	1.0 <=W	2 <	2 <	0
"	97/07/07	48601	2.2	1.0	2.2	3.8	1.37	1.0 <T	0.8 <T	0.2 <T	1.0 <=W	2 <	8	0
19	97/06/03	76861-SB	--	--	--	0.6 <T	0.08 <T	1.0 <=W	0.2 <=W	0.2 <T	1.0 <=W	--	--	--
"	"	76862-TB	--	--	--	0.4 <T	0.02 <T	1.0 <=W	--	--	--	--	--	--
17	97/07/08	48625-SB	--	--	--	0.2 <=W	0.11 <T	0.5 <=W	0.2 <=W	0.1 <=W	--	--	--	--
"	"	48626-TB	--	--	--	0.2 <=W	0.02 <T	0.5 <=W	--	--	--	--	--	--
PWQO:			--	--	--	--	--	--	--	--	--	100	--	--

NOTES: " < " = actual result is less than the reported value.
" <T " = a measurable trace amount: interpret with caution.
" <=W " = no measurable response (zero); less than reported value.
" -R " = field temporal replicate.
" -DC " = Depth Composite (bacteria sample taken at 1 metre depth).
" -SB " = System Blank.
" -TB " = Travel Blank.
" S24 " = Sample settled 20-40 % during 1 minute test period.

Table D-5. Inorganics and heavy metals concentrations in Lake Couchiching water samples.
All concentration in ug/l (ppb).

Station Number	Sample Date	Field Sample Number	Sample Depth, m	Aluminum	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese
1	97/06/03	76837	1.0	4.99 +/-1.10	0.5 <=W	28.9 +/-0.68	0.0991 +/-0.0370	0.0150 +/-0.0230	0.474 +/-0.270	0.0920 +/-0.0055	0.511 +/-0.110	15.0 +/-5.20	0.0927 +/-0.1400	4.16
•	97/07/08	48619	1.0	5.86 +/-0.57	0.5 <=W	32.4 +/-1.12	0.0052 +/-0.0066	-0.0078 +/-0.0206	1.90 +/-0.16	0.0513 +/-0.0153	0.452 +/-0.100	4.25 +/-2.43	0.0994 +/-0.1116	5.14
2	97/06/03	76838	1.0	5.14 +/-0.51	0.5 <=W	29.0 +/-0.75	0.0538 +/-0.0520	-0.0028 +/-0.0250	0.224 +/-0.082	0.0752 +/-0.0170	0.463 +/-0.100	9.41 +/-5.70	0.1690 +/-0.2200	2.84
•	97/07/08	48618	1.0	6.01 +/-0.49	0.5 <=W	34.7 +/-0.95	0.0290 +/-0.0205	-0.0023 +/-0.0213	2.46 +/-0.29	0.0148 +/-0.0175	0.339 +/-0.085	3.69 +/-2.35	0.0415 +/-0.0980	5.14
3	97/06/03	76839	1.0	4.83 +/-0.42	0.5 <=W	29.0 +/-1.60	0.0758 +/-0.0170	0.0280 +/-0.0320	0.267 +/-0.055	0.0683 +/-0.0180	0.532 +/-0.064	10.3 +/-7.10	0.2430 +/-0.1500	2.60
•	97/07/08	48617	1.0	7.49 +/-1.47	0.5 <=W	34.6 +/-1.20	0.0177 +/-0.0154	-0.0076 +/-0.0081	4.75 +/-0.27	0.0394 +/-0.0088	0.491 +/-0.084	4.16 +/-2.54	-0.0028 +/-0.1545	5.08
4	97/06/03	76840	1.0	11.7 +/-1.70	0.5 <=W	29.7 +/-0.88	0.0481 +/-0.0160	0.0450 +/-0.0260	0.731 +/-0.200	0.1740 +/-0.0150	1.29 +/-0.097	19.9 +/-5.00	0.5480 +/-0.1600	3.30
•	97/07/08	48616	1.0	6.08 +/-0.51	0.5 <=W	35.4 +/-0.77	0.0119 +/-0.0197	-0.0087 +/-0.0165	4.88 +/-0.29	0.0133 +/-0.0088	0.360 +/-0.074	1.77 +/-2.35	-0.0513 +/-0.0969	4.60
5	97/06/03	76841	1.0	5.07 +/-0.45	0.5 <=W	29.5 +/-0.83	0.0381 +/-0.0210	0.0184 +/-0.0450	0.297 +/-0.074	0.0429 +/-0.0170	0.492 +/-0.130	8.85 +/-8.20	0.1050 +/-0.1400	1.95
•	•	76842-DC	0.0-8.0	5.27 +/-0.63	0.5 <=W	30.3 +/-1.50	0.1120 +/-0.0850	0.0138 +/-0.0350	0.274 +/-0.110	0.0554 +/-0.0130	0.507 +/-0.062	9.53 +/-5.90	0.1640 +/-0.2000	2.51
•	97/07/08	48614-DC	0.0-8.0	7.55 +/-0.92	0.5 <=W	33.4 +/-0.91	0.0027 +/-0.0158	0.0046 +/-0.0167	4.69 +/-0.399	0.0221 +/-0.0072	0.440 +/-0.083	2.85 +/-2.49	0.0310 +/-0.1180	4.18
•	•	48615	8.0	8.05 +/-0.67	0.5 <=W	34.2 +/-1.04	0.0110 +/-0.0224	0.0071 +/-0.0248	3.96 +/-0.336	0.0189 +/-0.0082	0.393 +/-0.096	3.70 +/-2.99	0.1290 +/-0.2123	4.24
6	97/06/03	76844	1.0	5.63 +/-0.73	0.5 <=W	28.9 +/-1.20	0.0841 +/-0.0500	0.1180 +/-0.0330	0.243 +/-0.060	0.0713 +/-0.0190	0.502 +/-0.100	9.97 +/-5.90	0.2080 +/-0.2300	2.18
•	97/07/08	48613	1.0	5.73 +/-0.47	0.5 <=W	34.4 +/-0.79	-0.0002 +/-0.0119	0.0118 +/-0.0202	3.72 +/-0.332	0.0112 +/-0.0105	0.400 +/-0.084	1.86 +/-2.49	0.0451 +/-0.1172	4.15
7	97/06/03	76845	1.0	4.81 +/-0.45	0.5 <=W	30.0 +/-1.00	0.1240 +/-0.0630	0.1600 +/-0.0220	0.465 +/-0.089	0.0787 +/-0.0190	0.753 +/-0.130	9.98 +/-7.40	0.3690 +/-0.2400	1.73
•	97/07/08	48612	1.0	8.20 +/-0.67	0.5 <=W	32.3 +/-1.04	0.0073 +/-0.0029	0.0034 +/-0.0141	3.78 +/-0.407	0.0153 +/-0.0089	0.416 +/-0.084	4.44 +/-2.47	0.0112 +/-0.1190	3.94
8	97/06/03	76848	0.9	9.59 +/-0.94	0.5 <=W	29.5 +/-1.25	0.0087 +/-0.0078	0.0090 +/-0.0187	0.358 +/-0.098	0.0387 +/-0.0071	0.350 +/-0.052	12.3 +/-2.71	0.8440 +/-0.2428	2.29
•	97/07/07	48607	1.0	8.17 +/-0.76	0.5 <=W	26.8 +/-2.25	0.0384 +/-0.0432	0.0012 +/-0.0116	4.04 +/-0.57	0.0289 +/-0.0136	0.306 +/-0.115	11.3 +/-9.42	0.1280 +/-0.1047	3.71
9	97/06/03	76849	1.0	4.94 +/-0.41	0.5 <=W	29.8 +/-0.71	0.0317 +/-0.0092	-0.0002 +/-0.0166	3.16 +/-0.28	0.0191 +/-0.0108	0.360 +/-0.051	6.63 +/-2.43	-0.0734 +/-0.0813	1.50
•	97/07/07	48606	1.0	22.7 +/-28.7	0.5 <=W	42.4 +/-17.2	0.2710 +/-0.4389	0.0282 +/-0.0353	20.0 +/-26.8	-0.0189 +/-0.0161	0.735 +/-0.312	45.1 +/-69.99	0.6460 +/-0.6479	7.23
10	97/06/03	76850	1.0	4.46 +/-0.45	0.5 <=W	29.4 +/-0.63	0.0177 +/-0.0068	0.0100 +/-0.0170	1.10 +/-0.13	0.0356 +/-0.0218	0.300 +/-0.035	6.12 +/-2.43	0.1290 +/-0.0550	1.61
•	97/07/07	48605	1.0	6.50 +/-0.79	0.5 <=W	29.6 +/-1.29	0.0296 +/-0.0204	-0.0060 +/-0.0274	4.95 +/-1.18	-0.0014 +/-0.0048	0.307 +/-0.094	5.01 +/-6.57	0.1100 +/-0.1223	1.82
11	97/06/03	76851	1.0	5.84 +/-0.49	0.5 <=W	29.5 +/-1.06	0.0361 +/-0.0078	-0.0068 +/-0.0228	3.30 +/-0.34	0.0380 +/-0.0070	0.358 +/-0.053	8.17 +/-2.79	-0.1130 +/-0.0473	1.53
•	97/07/07	48604	1.0	7.69 +/-1.71	0.5 <=W	28.8 +/-0.82	0.0253 +/-0.0197	0.0093 +/-0.0216	4.68 +/-0.28	0.0192 +/-0.0177	0.802 +/-0.066	4.22 +/-2.92	0.1980 +/-0.0497	2.45
12	97/06/03	76852	1.0	5.85 +/-0.61	0.5 <=W	29.6 +/-0.70	0.0353 +/-0.0188	0.0013 +/-0.0205	4.07 +/-0.25	0.0536 +/-0.0080	0.463 +/-0.058	7.38 +/-3.86	-0.0208 +/-0.0791	1.56
•	97/07/07	48602	1.0	8.54 +/-0.74	0.5 <=W	29.4 +/-0.99	0.0323 +/-0.0067	-0.0017 +/-0.0172	4.30 +/-0.38	0.0099 +/-0.0056	0.249 +/-0.024	4.59 +/-2.82	-0.1530 +/-0.0523	1.98
13	97/06/03	76853	1.0	4.94 +/-0.41	0.5 <=W	28.9 +/-1.42	0.0319 +/-0.0142	-0.0083 +/-0.0211	3.63 +/-0.21	0.0368 +/-0.0076	0.402 +/-0.041	4.54 +/-2.52	-0.0307 +/-0.0817	1.51
•	97/07/07	48603	1.0	6.42 +/-0.62	0.5 <=W	29.7 +/-0.75	0.0389 +/-0.0097	0.0072 +/-0.0298	4.49 +/-0.35	0.0322 +/-0.0096	0.365 +/-0.024	3.39 +/-2.84	-0.0659 +/-0.0770	2.39
14	97/06/03	76854	1.0	6.77 +/-0.62	0.5 <=W	29.6 +/-0.91	0.0353 +/-0.0164	-0.0012 +/-0.0197	3.48 +/-0.30	0.0497 +/-0.0070	0.261 +/-0.026	6.83 +/-2.50	-0.1510 +/-0.0526	1.93
•	97/07/08	48608-R	1.0	7.02 +/-0.71	0.5 <=W	30.9 +/-1.51	0.0394 +/-0.0082	0.0163 +/-0.0402	5.49 +/-0.46	0.0059 +/-0.0150	0.427 +/-0.091	2.22 +/-2.31	0.0274 +/_0.1036	2.45
•	•	48609-R	1.0	6.81 +/-0.55	0.5 <=W	31.4 +/-0.67	0.0143 +/-0.0073	0.0362 +/-0.0151	4.83 +/-0.29	0.0541 +/-0.0188	0.816 +/-0.082	2.78 +/-2.37	0.4240 +/-0.1238	3.02
15	97/06/03	76855-DC	0.0-9.0	6.21 +/-0.65	0.5 <=W	29.5 +/-1.02	0.0228 +/-0.0064	0.0041 +/-0.0210	4.53 +/-0.24	0.0396 +/-0.0109	0.331 +/-0.023	6.43 +/-3.50	0.0890 +/-0.0797	1.51
•	97/07/08	48610-DC	0.0-8.5	7.76 +/-0.84	0.5 <=W	32.4 +/-0.75	0.0209 +/-0.0274	0.0177 +/-0.0094	4.50 +/-0.31	0.0116 +/-0.0060	0.491 +/-0.084	2.86 +/-2.53	0.0310 +/-0.1159	2.38
16	97/06/03	76856	1.0	7.78 +/-0.63	0.5 <=W	28.9 +-0.74	0.0261 +/-0.0171	-0.0068 +/-0.0168	2.40 +/-0.21	0.0538 +/-0.0236	0.304 +/-0.019	5.03 +/-2.42	-0.1290 +/-0.0498	4.22
•	97/07/08	48611	1.0	6.28 +/-0.57	0.5 <=W	33.1 +/-1.06	0.0223 +/-0.0201	-0.0024 +/-0.0144	5.71 +/-0.32	0.0304 +/-0.0164	0.592 +/-0.074	2.94 +/-2.41	0.1210 +/-0.1178	3.93
17	97/06/03	76857-R	1.0	4.13 +/-0.38	0.5 <=W	29.5 +/-0.83	0.0173 +/-0.0094	-0.0041 +/-0.0166	1.35 +/-0.11	0.0014 +/-0.0104	0.337 +/-0.030	5.20 +/-2.41	0.5650 +/-0.0969	2.66
•	•	76858-R	1.0	4.54 +/-0.42	0.5 <=W	29.0 +/-0.80	0.0194 +/-0.0187	0.0090 +/-0.0264	0.550 +/-0.161	0.0235 +/-0.0062	0.316 +/-0.019	6.94 +/-3.44	0.2110 +/-0.1092	2.79
•	97/07/08	48624	1.0	9.03 +/-0.74	0.5 <=W	34.4 +/-1.16	0.0079 +/-0.0040	0.0320 +/-0.0270	4.30 +/-0.31	0.0126 +/-0.0088	0.897 +/-0.084	7.05 +/-2.43	2.660 +/-0.309	4.85
18	97/06/03	76859	1.0	6.89 +/-0.58	0.5 <=W	30.1 +/-0.82	0.0107 +/-0.0171	-0.0024 +/-0.0198	0.380 +/-0.094	0.0680 +/-0.0185	0.462 +/-0.026	15.1 +/-2.88	0.0476 +/-0.0704	7.54
•	97/07/08	48622-R	1.0	17.2 +/-1.65	0.5 <=W	29.2 +/-0.95	0.0074 +/-0.0200	0.0006 +/-0.0113	3.53 +/-0.24	0.0301 +/-0.0206	0.455 +/-0.098	13.6 +/-2.72	-0.0690 +/-0.1399	3.29
•	•	48623-R	1.0	12.1 +/-0.98	0.5 <=W	30.0 +/-1.21	0.0216 +/-0.0124	-0.0021 +/-0.0156	5.21 +/-0.35	0.0606 +/-0.0088	0.558 +/-0.091	10.1 +/-2.58	1.6400 +/-0.2127	3.36
19	97/06/03	76860	1.0	6.25 +/-0.52	0.5 <=W	31.4 +/-0.70	0.0156 +/-0.0143	-0.0045 +/-0.0172	0.835 +/-0.11	0.0081 +/-0.0147	0.290 +/-0.018	4.93 +/-2.74	-0.1490 +/-0.0601	2.40
•	97/07/08	48621	1.0	5.89 +/-0.55	0.5 <=W	31.0 +/-0.89	0.0315 +/-0.0302	0.0037 +/-0.0194	4.05 +/-0.30	-0.0073 +/-0.0117	0.459 +/-0.074	2.28 +/-2.50	0.1600 +/-0.1067	3.29
20	97/06/03	76843	1.0	7.31 +/-0.71	0.5 <=W	28.8 +/-0.58	0.0785 +/-0.0310	0.0038 +/-0.0230	0.336 +/-0.120	0.0614 +/-0.0084	0.566 +/-0.130	11.9 +/-6.90	0.2270 +/-0.2000	2.80
•	97/07/08	48620	1.0	10.3 +/-1.09	0.5 <=W	32.7 +/-0.83	0.0138 +/-0.0231	0.0194 +/-0.0116	2.91 +/-0.26	0.0300 +/-0.0080	0.365 +/-0.079	5.89 +/-2.37	0.2450 +/-0.1068	6.13
21	97/06/03	76846-R	1.0	5.34 +/-0.78	0.5 <=W	29.3 +/-0.75	0.0525 +/-0.0360	-0.0081 +/-0.0230	0.262 +/-0.086	0.0739 +/-0.0110	0.507 +/-0.110	10.9 +/-5.80	0.1650 +/-0.2000	1.76

Table D-5. Inorganics and heavy metals concentrations in Lake Couchiching water samples.
All concentration in ug/l (ppb).

Station Number	Sample Date	Field Sample Number	Sample Depth, m	Aluminum		Arsenic		Barium		Beryllium		Cadmium		Chromium		Cobalt		Copper		Iron		Lead		Manganese
"	"	76847-R	1.0	6.25	+/-0.98	0.5	<=W	29.8	+/-1.10	0.0484	+/-0.0450	0.0064	+/-0.0240	0.283	+/-0.140	0.0633	+/-0.0160	0.399	+/-0.093	10.8	+/_4.80	0.2500	+/-0.1800	1.84
"	97/07/07	48601	1.0	6.67	+/-0.57	0.5	<=W	31.1	+/-0.64	0.0379	+/-0.0093	-0.0003	+/-0.0222	4.63	+/-0.47	0.0132	+/-0.0097	0.124	+/-0.047	3.15	+/-2.46	-0.1690	+/-0.0668	3.16
Mean & Std. Dev'n.,	97/06/03			6.02	+/-1.73	0.5	<=W	29.5	+/-0.6	0.0451	+/-0.0307	0.0165	+/-0.0402	1.37	+/-1.47	0.0551	+/-0.0340	0.461	+/-0.210	9.26	+/-3.73	0.1566	+/-0.2423	2.53
Mean & Std. Dev'n.,	97/07/07-08			8.50	+/-3.91	0.5	<=W	32.3	+/-3.1	0.0307	+/-0.0526	0.0067	+/-0.0126	4.91	+/-3.34	0.0207	+/-0.0187	0.468	+/-0.186	6.38	+/-8.78	0.2582	+/-0.6263	3.83
19	97/06/03	76861-SB		3.69	+/-0.32	0.5	<=W	0.668	+/-0.036	0.0117	+/-0.0061	0.0090	+/-0.0237	0.185	+/-0.079	0.0502	+/-0.0086	4.61	+/-0.234	2.34	+/-2.78	-0.0696	+/-0710	0.252
"	"	76862-TB		0.938	+/-0.122	0.5	<=W	0.298	+/-0.012	0.0249	+/-0.0185	-0.0169	+/-0.0188	0.075	+/-0.081	0.0703	+/-0.0076	-0.136	+/-0.024	1.07	+/-2.91	-0.2790	+/-0.0822	0.094
17	97/07/08	48625-SB		1.01	+/-0.13	0.5	<=W	0.721	+/-0.021	-0.0042	+/-0.0052	0.0297	+/-0.0271	0.266	+/-0.115	0.0556	+/-0.0092	0.425	+/-0.092	3.03	+/-2.64	0.3730	+/-0.1403	0.346
"	"	48626-TB		0.751	+/-0.081	0.5	<=W	0.916	+/-0.044	0.0070	+/-0.0159	0.0427	+/-0.0165	0.118	+/-0.101	0.0815	+/-0.0056	0.580	+/-0.079	0.373	+/-2.319	0.0377	+/-0.1919	0.244
PWQO:				75		100		–		1100		0.2		1.0 (CrVI) 8.9 (CrIII)		0.9		5		300		5		–

NOTES: " +/- " = 95 % Confidence Limits, unless otherwise specified.
" <=W " = no measurable response (zero): less than reported value.
" -R " = field temporal replicate.
" -DC " = Depth Composite.
" -SB " = System Blank.
"- TB " = Travel Blank.
italicized and bolded values exceed PWQO for the protection of aquatic life.

Table D-5. Inorganics and heavy metals concentrations in Lake Couchiching water samples.
All concentration in ug/l (ppb).

Station Number	Sample Date	Field Sample Number	Sample Depth, m		Mercury		Molybdenum		Nickel		Strontium		Titanium		Vanadium		Zinc	
1	97/06/03	76837	1.0	+/-0.72	0.02	<=W	0.503	+/-0.087	-0.0976	+/-0.2800	156	+/-8.5	8.92	+/-1.80	0.439	~/-0.043	1.160	+/-0.180
*	97/07/08	48619	1.0	+/-0.18	0.01	<=W	0.452	+/-0.024	-0.0839	+/-0.0289	142	+/-7.5	9.32	+/-0.78	0.586	+/-0.032	0.976	+/-0.182
2	97/06/03	76838	1.0	+/-0.22	0.01	<=W	0.488	+/-0.062	0.2870	+/-0.2200	146	+/-9.0	8.98	+/-0.77	0.411	+/-0.072	1.180	+/-0.300
*	97/07/08	48618	1.0	+/-0.14	0.02	<=W	0.477	+/-0.026	-0.0239	+/-0.0872	142	+/-7.6	10.1	+/-0.69	0.629	+/-0.041	0.512	+/-0.164
3	97/06/03	76839	1.0	+/-0.07	0.02	<=W	0.485	+/-0.025	0.1350	+/-0.2100	144	+/-7.2	8.30	+/-0.57	0.407	+/-0.050	1.160	+/-0.240
*	97/07/08	48617	1.0	+/-0.20	0.02	<=W	0.427	+/-0.036	-0.0750	+/-0.0554	147	+/-9.1	9.63	+/-0.70	0.632	+/-0.037	1.700	+/-0.207
4	97/06/03	76840	1.0	+/-0.38	0.02	<=W	0.592	+/-0.076	0.4740	+/-0.1200	154	+/-9.2	9.50	+/-1.20	0.463	+/-0.027	4.380	+/-0.480
*	97/07/08	48616	1.0	+/-0.12	0.02	<=W	0.396	+/-0.023	0.1280	+/-0.2197	143	+/-7.7	9.67	+/-0.73	0.655	+/-0.043	0.547	+/-0.159
5	97/06/03	76841	1.0	+/-0.09	0.02	<=W	0.531	+/-0.036	-0.0262	+/-0.2500	159	+/-8.4	9.04	+/-0.61	0.401	+/-0.072	1.920	+/-0.410
*	*	76842-DC	0.0-8.0	+/-0.18	0.02	<=W	0.491	+/-0.037	0.1420	+/-0.1700	154	+/-12.0	8.84	+/-0.93	0.468	+/-0.096	1.360	+/-0.370
*	97/07/08	48614-DC	0.0-8.0	+/-0.17	0.01	<=W	0.413	+/-0.025	0.1370	+/-0.1402	145	+/-7.5	9.17	+/-0.64	0.650	+/-0.043	0.845	+/-0.180
*	*	48615	8.0	+/-0.21	0.02	<=W	0.424	+/-0.034	0.1730	+/-0.1039	143	+/-7.7	9.54	+/-0.66	0.667	+/-0.061	1.080	+/-0.222
6	97/06/03	76844	1.0	+/-0.23	0.02	<=W	0.429	+/-0.051	0.0709	+/-0.1200	146	+/-8.0	8.90	+/-0.70	0.432	+/-0.062	1.500	+/-0.310
*	97/07/08	48613	1.0	+/-0.13	0.02	<=W	0.449	+/-0.053	0.0058	+/-0.1056	145	+/-10.2	8.71	+/-0.59	0.658	+/-0.038	0.626	+/-0.171
7	97/06/03	76845	1.0	+/-0.09	0.02	<=W	0.460	+/-0.026	0.1630	+/-0.180	147	+/-9.0	8.40	+/-0.64	0.457	+/-0.027	2.170	+/-0.210
*	97/07/08	48612	1.0	+/-0.10	0.02	<=W	0.443	+/-0.028	-0.0488	+/-0.1169	146	+/-7.4	8.66	+/-0.60	0.640	+/-0.039	0.794	+/-0.170
8	97/06/03	76848	0.9	+/-0.07	0.02	<=W	0.518	+/-0.062	-0.3070	+/-0.1236	140	+/-10.7	7.22	+/-0.55	0.449	+/-0.045	1.080	+/-0.158
*	97/07/07	48607	1.0	+/-0.14	0.02	<=W	0.532	+/-0.108	-0.4810	+/-0.3109	144	+/-16.9	6.47	+/-0.52	0.671	+/-0.070	0.572	+/-0.236
9	97/06/03	76849	1.0	+/-0.04	0.02	<=W	0.482	+/-0.031	-0.3070	+/-0.1038	143	+/-8.9	7.02	+/-0.47	0.456	+/-0.025	1.680	+/-0.182
*	97/07/07	48606	1.0	+/-9.38	0.02	<=W	0.637	+/-0.137	-0.9390	+/-0.6437	190	+/-40.0	24.4	+/-29.8	1.920	+/-2.339	0.621	+/-0.353
10	97/06/03	76850	1.0	+/-0.08	0.02	<=W	0.495	+/-0.028	-0.2670	+/-0.1165	142	+/-8.3	7.21	+/-0.45	0.459	+/-0.039	1.410	+/-0.176
*	97/07/07	48605	1.0	+/-0.17	0.01	<=W	0.333	+/-0.029	-0.4870	+/-0.0974	139	+/-8.3	7.43	+/-0.75	0.553	+/-0.081	0.451	+/-0.258
11	97/06/03	76851	1.0	+/-0.06	0.02	<=W	0.467	+/-0.027	-0.3180	+/-0.0593	142	+/-7.6	6.75	+/-0.43	0.455	+/-0.024	2.070	+/-0.182
*	97/07/07	48604	1.0	+/-0.18	0.02	<=W	0.429	+/-0.024	-0.3320	+/-0.0837	138	+/-6.9	8.37	+/-1.07	0.604	+/-0.045	0.862	+/-0.168
12	97/06/03	76852	1.0	+/-0.13	0.01	<=W	0.466	+/-0.029	-0.2790	+/-0.2443	141	+/-7.5	7.53	+/-0.87	0.495	+/-0.047	5.110	+/-0.432
*	97/07/07	48602	1.0	+/-0.05	0.02	<=W	0.432	+/-0.024	-0.2860	+/-0.0851	136	+/-6.9	7.04	+/-0.44	0.656	+/-0.041	0.245	+/-0.096
13	97/06/03	76853	1.0	~/-0.05	0.02	<=W	0.449	+/-0.039	-0.2130	+/-0.1412	140	+/-7.6	7.18	+/-0.47	0.471	+/-0.028	1.890	+/-0.231
*	97/07/07	48603	1.0	+/-0.07	0.02	<=W	0.400	+/-0.031	-0.3410	+/-0.2067	136	+/-6.8	7.13	+/-0.51	0.619	+/-0.035	0.899	+/-0.108
14	97/06/03	76854	1.0	+/-0.06	0.02	<=W	0.453	+/-0.027	-0.2140	+/-0.2750	138	+/-7.1	7.30	+/-0.55	0.469	+/-0.026	3.520	+/-0.316
*	97/07/08	48608-R	1.0	+/-0.12	0.01	<=W	0.492	+/-0.047	-0.1620	+/-0.1091	141	+/-7.6	8.33	+/-0.78	0.630	+/-0.059	0.657	+/-0.159
*	*	48609-R	1.0	+/-0.09	0.01	<=W	0.487	+/-0.050	0.3190	+/-0.0652	142	+/-7.9	8.09	+/-0.55	0.645	+/-0.033	2.860	+/-0.303
15	97/06/03	76855-DC	0.0-9.0	+/-0.11	0.02	<=W	0.427	+/-0.033	-0.3060	+/-0.0674	139	+/-7.8	7.30	+/-0.88	0.483	+/-0.034	9.750	+/-0.851
*	97/07/08	48610-DC	0.0-8.5	+/-0.09	0.02	<=W	0.454	+/-0.033	-0.0451	+/-0.2060	140	+/-7.1	8.66	+/-0.60	0.599	+/-0.050	1.070	+/-0.208
16	97/06/03	76856	1.0	+/-0.20	0.01	<=W	0.439	+/-0.042	-0.1200	+/-0.1874	143	+/-7.9	7.46	+/-0.64	0.495	+/-0.032	19.20	+/-1.612
*	97/07/08	48611	1.0	+/-0.20	0.02	<=W	0.438	+/-0.027	-0.0666	+/-0.1169	141	+/-7.6	8.55	+/-0.62	0.666	+/-0.035	0.641	+/-0.169
17	97/06/03	76857-R	1.0	+/-0.06	0.01	<=W	0.420	+/-0.023	-0.1510	+/-0.0652	139	+/-7.6	7.25	+/-0.48	0.485	+/-0.037	0.598	+/-0.103
*	*	76858-R	1.0	+/-0.11	0.02	<=W	0.503	+/-0.028	-0.1930	+/-0.1564	144	+/-8.8	7.27	+/-0.56	0.470	+/-0.032	3.910	+/-0.359
*	97/07/08	48624	1.0	+/-0.12	0.02	<=W	0.443	+/-0.024	-0.1860	+/-0.1127	143	+/-9.2	9.92	+/-1.01	0.683	+/-0.049	2.530	+/-0.267
18	97/06/03	76859	1.0	+/-0.16	0.02	<=W	0.484	+/-0.033	-0.1990	+/-0.2969	143	+/-8.2	7.54	+/-0.54	0.559	+/-0.034	1.990	+/-0.268
*	97/07/08	48622-R	1.0	+/-0.15	0.02	<=W	0.413	+/-0.054	0.1070	+/-0.3161	148	+/-7.6	9.46	+/-0.58	0.728	+/-0.055	0.941	+/-0.183
*	*	48623-R	1.0	+/-0.09	0.02	<=W	0.461	+/-0.063	-0.1220	+/-0.0531	150	+/-8.0	9.66	+/-0.60	0.699	+/-0.051	3.540	+/-0.343
19	97/06/03	76860	1.0	+/-0.06	0.01	<=W	0.462	+/-0.028	-0.3310	+/-0.0332	140	+/-7.3	7.79	+/-0.49	0.555	+/-0.041	1.010	+/-0.134
*	97/07/08	48621	1.0	+/-0.10	0.02	<=W	0.445	+/-0.031	-0.1960	+/-0.1888	145	+/-7.9	9.46	+/-0.69	0.601	+/-0.037	1.300	+/-0.262
20	97/06/03	76843	1.0	+/-0.08	0.02	<=W	0.475	+/-0.355	-0.0311	+/-0.0730	156	+/-9.1	9.06	+/-0.62	0.489	+/-0.082	1.450	+/-0.200
*	97/07/08	48620	1.0	+/-0.16	0.02	<=W	0.447	+/-0.026	-0.0731	+/-0.1679	140	+/-7.4	9.10	+/-0.75	0.633	+/-0.037	1.000	+/-0.182
21	97/06/03	76846-R	1.0	+/-0.10	0.02	<=W	0.438	+/-0.023	0.1240	+/-0.210	151	+/-14.0	8.97	+/-0.65	0.422	+/-0.049	1.140	+/-0.300

Table D-5. Inorganics and heavy metals concentrations in Lake Couchiching water samples.

All concentration in ug/l (ppb).

Station Number	Sample Date	Field Sample Number	Sample Depth, m		Mercury		Molybdenum		Nickel		Strontium		Titanium		Vanadium		Zinc	
"	"	76847-R	1.0	+/-0.31	***0.25***		0.435	+/-0.035	0.3990	+/-0.150	145	+/-8.7	9.02	+/-1.60	0.424	+/-0.058	1.630	+/-0.360
"	97/07/07	48601	1.0	+/-0.11	0.02	<=W	0.427	+/-0.024	-0.2240	+/-0.114	139	+/-7.2	7.50	+/-0.54	0.577	+/-0.038	0.200	+/-0.107
Mean & Std. Dev'n.,	97/06/03			+/-1.32	0.02	<=W	0.475	+/-0.039	-0.0632	+/-0.2385	146	+/-6.2	8.03	+/-0.87	0.463	+/-0.040	3.011	+/-3.961
Mean & Std. Dev'n.,	97/07/07-08			+/-1.34	0.02	<=W	0.456	+/-0.052	-0.1376	+/-0.2616	144	+/-10.3	9.35	+/-3.36	0.692	+/-0.265	1.061	+/-0.821
19	97/06/03	76861-SB		+/-0.033	0.02	<=W	0.0284	+/-0.0131	0.0853	+/-0.0724	2.54	+/-0.13	0.249	+/-0.064	0.0414	+/-0.0099	5.750	+/-0.551
"	"	76862-TB		+/-0.025	0.02	<=W	0.0220	+/-0.0117	0.0075	+/-0.0364	0.375	+/-0.020	0.067	+/-0.058	0.0188	+/-0.0040	-0.0167	+/-0.0880
17	97/07/08	48625-SB		+/-0.041	0.02	<=W	0.0178	+/-0.0061	0.2020	+/-0.0570	0.902	+/-0.055	0.299	+/-0.189	0.0271	+/-0.0134	2.930	+/-0.313
"	"	48626-TB		+/-0.042	0.02	<=W	0.0077	+/-0.0068	0.3740	+/-0.0283	1.05	+/-0.091	0.206	+/-0.100	0.0054	+/-0.0107	1.810	+/-0.268
PWQO:					0.2		10		25		–		–		6		30	

NOTES: " +/- " = 95 % Confidence Limits, unless otherwise specified.

" <=W " = no measurable response (zero): less than reported value.

" -R " = field temporal replicate.

" -DC " = Depth Composite.

" -SB " = System Blank.

"- TB " = Travel Blank.

italicized and bolded values exceed PWQO for the protection of aquatic life.

Table D-6. Triazine herbicides concentrations in Lake Couchiching water samples.
All concentrations in ng/l (ppt).

Station Number	Sample Date	Field Sample Number	Alachlor	Ametryne	Atratone	Atrazine	De-ethylated Atrazine	Cyanazine	Metolachlor	Metribuzin	Prometone	Prometryne	Propazine	Simazine	De-ethylated Simazine
1	97/06/03	76837	500 <=W	50 <=W	50 <=W	50 <=W	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
2	97/06/03	76838	500 <=W	50 <=W	50 <=W	66 <T	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
3	97/06/03	76839	500 <=W	50 <=W	50 <=W	84 <T	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
4	97/06/03	76840	500 <=W	50 <=W	50 <=W	96 <T	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
5	97/06/03	76841	500 <=W	50 <=W	50 <=W	130 <T	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
*	*	76842-DC	500 <=W	50 <=W	50 <=W	140 <T	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
6	97/06/03	76844	500 <=W	50 <=W	50 <=W	120 <T	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
7	97/06/03	76845	500 <=W	50 <=W	50 <=W	110 <T	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
8	97/06/03	76848	500 <=W	50 <=W	50 <=W	140 <T	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
9	97/06/03	76849	500 <=W	50 <=W	50 <=W	120 <T	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
10	97/06/03	76850	500 <=W	50 <=W	50 <=W	120 <T	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
11	97/06/03	76851	500 <=W	50 <=W	50 <=W	110 <T	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
12	97/06/03	76852	500 <=W	50 <=W	50 <=W	50 <=W	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
13	97/06/03	76853	500 <=W	50 <=W	50 <=W	50 <=W	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
14	97/06/03	76854	500 <=W	50 <=W	50 <=W	50 <=W	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
15	97/06/03	76855-DC	500 <=W	50 <=W	50 <=W	54 <T	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
16	97/06/03	76856	500 <=W	50 <=W	50 <=W	50 <=W	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
17	97/06/03	76857-R	500 <=W	50 <=W	50 <=W	50 <=W	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
*	*	76858-R	500 <=W	50 <=W	50 <=W	50 <=W	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
18	97/06/03	76859	500 <=W	50 <=W	50 <=W	50 <=W	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
19	97/06/03	76860	500 <=W	50 <=W	50 <=W	50 <=W	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
20	97/06/03	76843	500 <=W	50 <=W	50 <=W	130 <T	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
21	97/06/03	76846-R	500 <=W	50 <=W	50 <=W	120 <T	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
*	*	76847-R	500 <=W	50 <=W	50 <=W	110 <T	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
Mean & Std. Dev'n.			--	--	--	67 +/-38	--	--	--	--	--	--	--	--	--
19	97/06/03	76861-SB	500 <=W	50 <=W	50 <=W	50 <=W	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
*	*	76862-TB	500 <=W	50 <=W	50 <=W	50 <=W	200 <=W	100 <=W	500 <=W	100 <=W	50 <=W	50 <=W	50 <=W	50 <=W	200 <=W
IPWQO:			--	--	--	--	--	--	3000	--	--	--	--	--	--

NOTES: blank or "--" indicates that data is not available for this parameter or sample.

"<=W" = no measurable response (zero): less than reported value.

"<T" = a measurable trace amount: interpret with caution.

" -R " = field temporal replicate.

" -DC " = Depth Composite.

" -SB " = System Blank.

" -TB " = Travel Blank.

Table D-7. Phenoxy acid herbicides concentrations in Lake Couchiching water samples.

All concentrations in ng/l (ppt).

Station Number	Sample Date	Field Sample Number	Bromoxynil	Dicamba	Dinoseb	Diclofop-methyl	2,4-D	2,4-DB	2,4-D Propionic Acid	2,4,5-T	Picloram	Silvex
1	97/06/03	76837	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
2	97/06/03	76838	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
3	97/06/03	76839	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
4	97/06/03	76840	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
5	97/06/03	76841	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
"	"	76842-DC	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
6	97/06/03	76844	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
7	97/06/03	76845	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
8	97/06/03	76848	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
9	97/06/03	76849	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
10	97/06/03	76850	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
11	97/06/03	76851	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
12	97/06/03	76852	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
13	97/06/03	76853	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
14	97/06/03	76854	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
15	97/06/03	76855-DC	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
16	97/06/03	76856	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
17	97/06/03	76857-R	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
"	"	76858-R	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
18	97/06/03	76859	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
19	97/06/03	76860	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
20	97/06/03	76843	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
21	97/06/03	76846-R	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
"	"	76847-R	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
19	97/06/03	76861-SB	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
"	"	76862-TB	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
PWQO:			--	200000	--	--	4000	--	--	--	--	--

NOTES: blank or "--" indicates that data is not available for this parameter or sample.

" <=W " = no measurable response (zero): less than reported value.

" -R " = field temporal replicate.

" -DC " = Depth Composite.

" -SB " = System Blank.

" -TB " = Travel Blank.

Table D-7. Phenoxy acid herbicides concentrations in Lake Couchiching water samples.
All concentrations in ng/l (ppt).

Station Number	Sample Date	Field Sample Number	Bromoxynil	Dicamba	Dinoseb	Diclofop-methyl	2,4-D	2,4-DB	2,4-D Propionic Acid	2,4,5-T	Picloram	Silvex
1	97/06/03	76837	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
2	97/06/03	76838	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
3	97/06/03	76839	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
4	97/06/03	76840	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
5	97/06/03	76841	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
"	"	76842-DC	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
6	97/06/03	76844	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
7	97/06/03	76845	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
8	97/06/03	76848	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
9	97/06/03	76849	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
10	97/06/03	76850	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
11	97/06/03	76851	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
12	97/06/03	76852	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
13	97/06/03	76853	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
14	97/06/03	76854	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
15	97/06/03	76855-DC	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
16	97/06/03	76856	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
17	97/06/03	76857-R	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
"	"	76858-R	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
18	97/06/03	76839	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
19	97/06/03	76860	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
20	97/06/03	76843	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
21	97/06/03	76846-R	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
"	"	76847-R	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
19	97/06/03	76861-SB	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
"	"	76862-TB	50 <=W	50 <=W	20 <=W	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	20 <=W
PWQO:			--	200000	--	--	4000	--	--	--	--	--

NOTES: blank or "--" indicates that data is not available for this parameter or sample.
" <=W " = no measurable response (zero): less than reported value.
" -R " = field temporal replicate.
" -DC " = Depth Composite.
" -SB " = System Blank.
" -TB " = Travel Blank.

Table D-8. Chlorinated phenols concentrations in Lake Couchiching water samples.

All concentrations in ng/l (ppt).

Station Number	Sample Date	Field Sample Number	2,4-Dichloro-phenol	2,3,4-Trichlor-phenol	2,4,5-Trichlor-phenol	2,4,6-Trichlor-phenol	2,3,4,5-Tetrachloro-phenol	2,3,4,6-Tetrachloro-phenol	Penta-chloro-phenol
1	97/06/03	76837	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
2	97/06/03	76838	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
3	97/06/03	76839	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
4	97/06/03	76840	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
5	97/06/03	76841	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
"	"	76842-DC	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
6	97/06/03	76844	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
7	97/06/03	76845	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
8	97/06/03	76848	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
9	97/06/03	76849	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
10	97/06/03	76850	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
11	97/06/03	76851	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
12	97/06/03	76852	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
13	97/06/03	76853	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
14	97/06/03	76854	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
15	97/06/03	76855-DC	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
16	97/06/03	76856	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
17	97/06/03	76857-R	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
"	"	76858-R	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
18	97/06/03	76859	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
19	97/06/03	76860	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
20	97/06/03	76843	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
21	97/06/03	76846-R	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
"	"	76847-R	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
19	97/06/03	76861-SB	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
"	"	76862-TB	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
PWQO:			200	18	18	18	1000	1000	500

NOTES: blank or "--" indicates that data is not available for this parameter or sample.

"<=W" = no measurable response (zero): less than reported value.

" -R " = field temporal replicate.

"-DC " = Depth Composite.

" - SB " = System Blank.

" - TB " = Travel Blank.

Table D-8. Chlorinated phenols concentrations in Lake Couchiching water samples.

All concentrations in ng/l (ppt).

Station Number	Sample Date	Field Sample Number	2,4-Dichloro-phenol	2,3,4-Trichlor-phenol	2,4,5-Trichlor-phenol	2,4,6-Trichlor-phenol	2,3,4,5-Tetrachloro-phenol	2,3,4,6-Tetrachloro-phenol	Penta-chloro-phenol
1	97/06/03	76837	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
2	97/06/03	76838	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
3	97/06/03	76839	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
4	97/06/03	76840	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
5	97/06/03	76841	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
"	"	76842-DC	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
6	97/06/03	76844	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
7	97/06/03	76845	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
8	97/06/03	76848	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
9	97/06/03	76849	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
10	97/06/03	76850	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
11	97/06/03	76851	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
12	97/06/03	76852	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
13	97/06/03	76853	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
14	97/06/03	76854	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
15	97/06/03	76855-DC	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
16	97/06/03	76856	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
17	97/06/03	76857-R	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
"	"	76858-R	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
18	97/06/03	76859	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
19	97/06/03	76860	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
20	97/06/03	76843	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
21	97/06/03	76846-R	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
"	"	76847-R	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
19	97/06/03	76861-SB	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
"	"	76862-TB	2000 <=W	100 <=W	100 <=W	20 <=W	20 <=W	20 <=W	10 <=W
PWQO			200	18	18	18	1000	1000	500

NOTES: blank or "--" indicates that data is not available for this parameter or sample.

"<=W" = no measurable response (zero); less than reported value

" -R " = field temporal replicate

"-DC " = Depth Composite

" - SB " = System Blank

" - TB " = Travel Blank

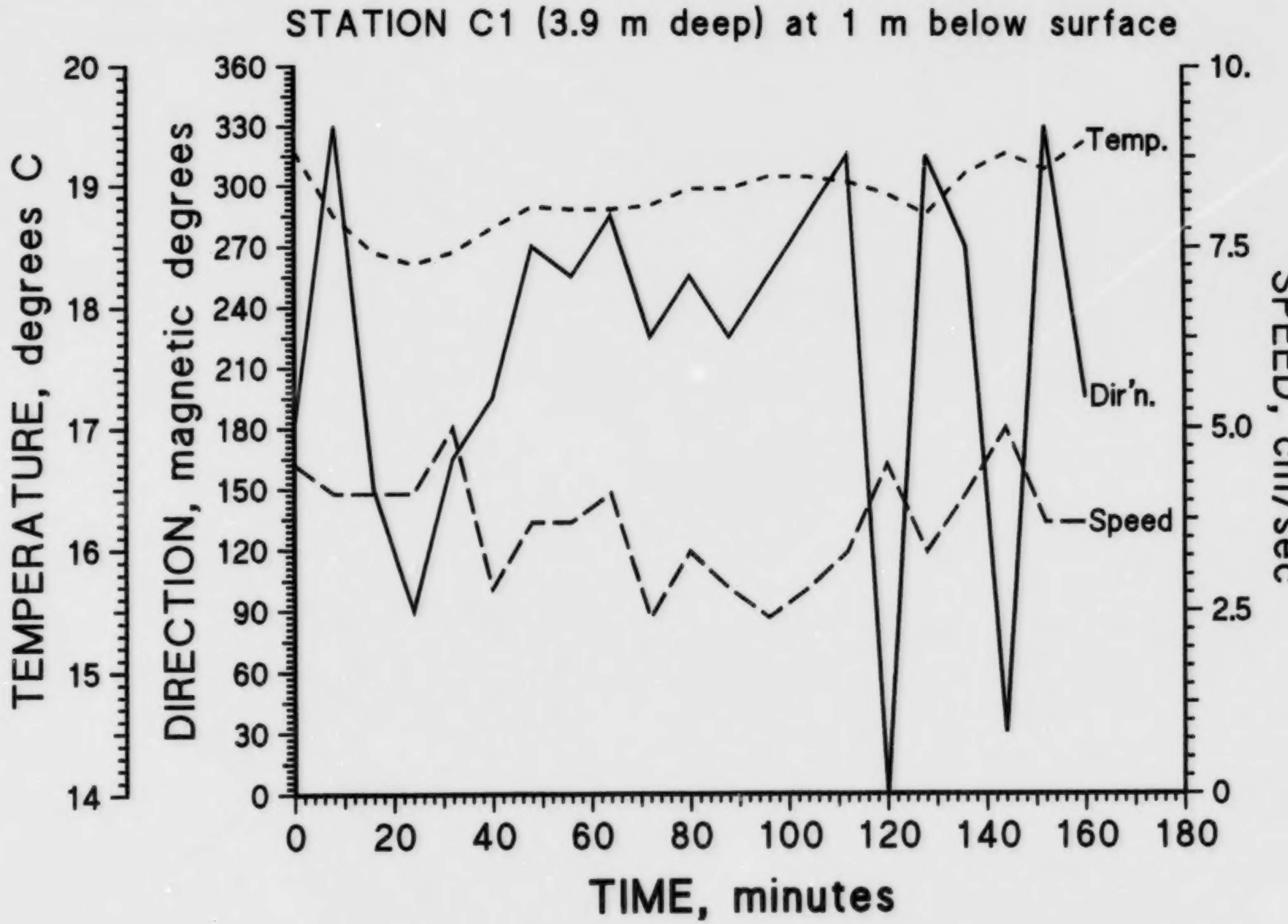

Figure D-1. Temperature, current speed and direction at Station C1 at 1 m below surface.

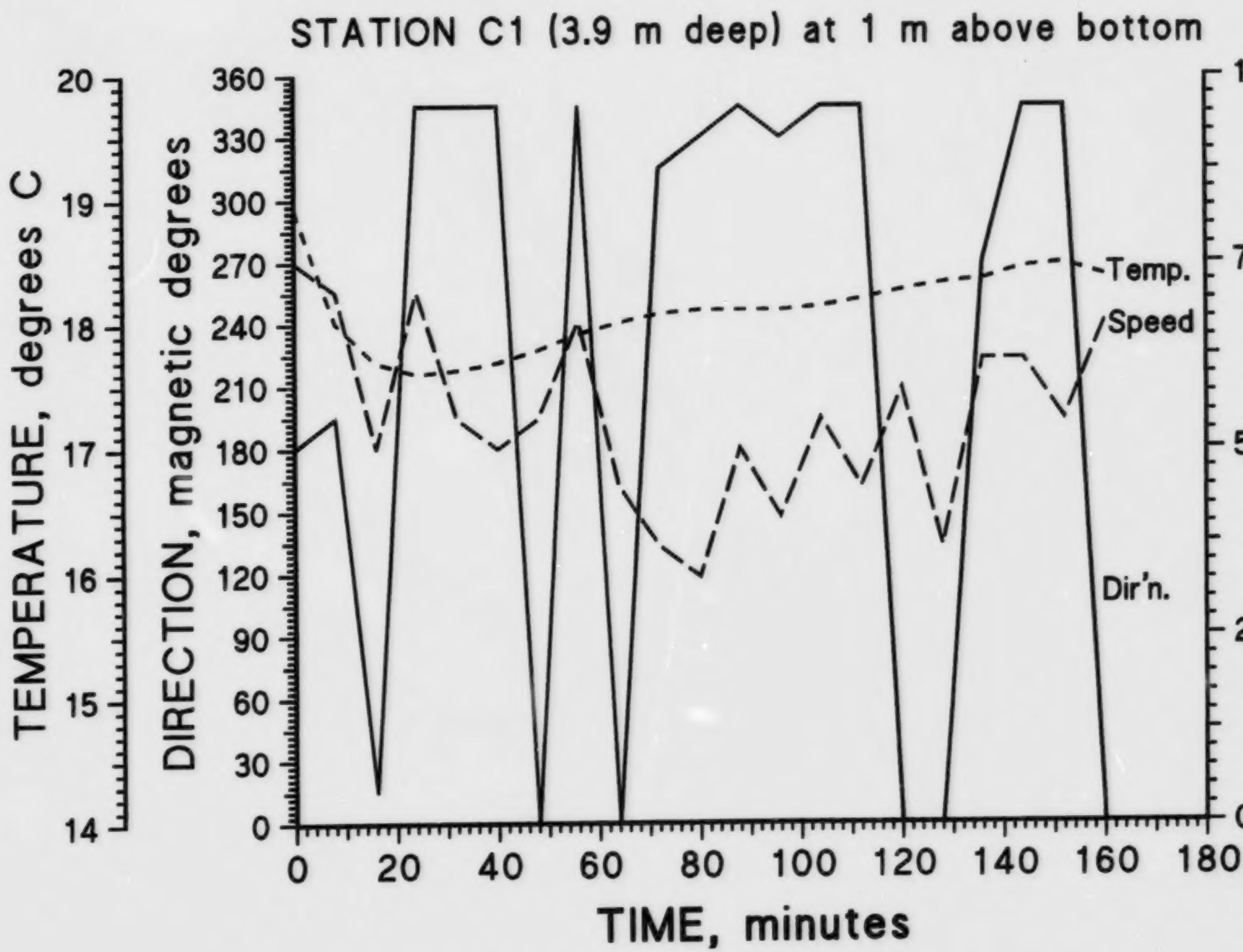

Figure D-2. Temperature, current speed and direction at Station C1 at 1 m above bottom.

Appendix E

Appendix E Sediment Core Data

List of Tables and Figures

Table E-1. Field observations of Lake Couchiching sediment core samples.

Station Number	Sample Date	Sediment Depth, cm	Field Sample Number	Description	Odour	Fauna	Flora
5	97/06/04	0 - 5	76365	cohesive, gray-brown, watery ooze	slight H2S	sparse chironomids	sparse filamentous algae on surface
"	"	5 - 15	76366	less watery gray ooze; sparse marl	very slight H2S		--
"	"	15 - 25	76367	gray, more cohesive silt; moderate marl; moderate gas pockets	almost no H2S	snail shells	--
"	"	25 - 35	76368	still more cohesive gray silt; moderate marl; moderate gas pockets	almost no H2S	snail shells	--
"	"	35 - 45	76369	packed, gray silt; moderate marl; moderate gas pockets	still less H2S	snail shells	--
"	"	45 - 55	76370	much thicker & drier gray silt; moderate marl; sparse air pockets	--	snail shells	--
"	"	55 - 65	76371	thicker, sticky, cohesive gray silt; less marl	--	snail shells	--
"	"	65 - 75	76372	thicker, drier, very cohesive gray silt; moderate fine marl	--	snail shells	--
"	"	75 - 85	76373	still thicker & drier gray; moderate fine marl	--	snail shells	--
"	"	85 - 95	76374	stil drier, gray; moderate fine marl; piece of bark	--	snail shells	--
"	"	95 - 105	76375	thicker & drier gray mud (almost clay-like); moderate fine marl	--	--	--
"	"	105 - 115	76376	thicker & still drier gray mud (almost clay-like); moderate fine marl	--	--	--
15	97/06/04	0 - 5	76377	watery, gray ooze	--	1/2 mussel shell	--
"	"	5 - 15	76378	less watery, gray ooze	--	1/2 mussel shell	--
"	"	15 - 25	76379	thicker, gray ooze; sparse, fine marl	--	--	--
"	"	25 - 35	76380	thicker gray ooze; sparse fine marl	--	sparse fingernail clam & snail shells	--
"	"	35 - 45	76381	thicker gray ooze; sparse fine marl; some small gas pockets	--	--	--
"	"	45 - 55	76382	thicker cohesive, jelly-like gray muck; very sparse marl	--	sparse fingernail clam shells	--
"	"	55 - 65	76383	very thick, more clay-like, drier gray mud; small gas pockets	--	moderate no. of fingernail clam shells	--
"	"	65 - 75	76384	thicker, more clay-like gray mud; moderate marl; small gas pockets	--	snail shells	--
"	"	75 - 85	76385	very thick, cly-like gray; moderate very fine marl; small gas pockets	--	--	--
"	"	85 - 95	76386	very thick gray mud; small gas pockets; very sparse marl	--	--	--
"	"	95 - 105	76387	hard, dense, dry gray clay; small gas pockets	--	--	--
"	"	105 - 124	76388	very dry, gray clay; moderate marl	--	fingernail clam shells; large mussel shell	--

Table E-2. Particle size, macro-ion, nutrient, organic carbon and solvent extractables concentrations in Lake Couchiching sediment cores.

Concentration units as noted: % = percent; g/kg = ppth; mg/kg = ppm. Except for particle size, all results are on dry weight basis.

Station Number	Sample Date	Sediment Depth, cm	Field Sample Number	Field Density g/cm3	Moisture %	Coarse Sand 2000-1000 um %	Sand 1000-63 um %	Silt& Clay <63 um %	Residue, total loss on ignition g/kg	Organic Carbon, total g/kg	Calcium, unf. total mg/kg	Magnesium, unf. total mg/kg	Chloride, aq. extr. mg/kg
5	97/06/04	0-5	76365	1.21	74	0.00	21.83	78.17	78	***43***	260000	4500	78
"	"	5-15	76366	1.29	66	0.00	31.36	68.64	69	***39***	260000	4400	59
"	"	15-25	76367	1.28	65	0.00	27.08	72.92	69	***39***	270000	4500	51
"	"	25-35	76368	1.32	61	0.08	35.65	64.27	65	***34***	270000	4500	34
"	"	35-45	76369	1.34	58	0.00	31.43	68.57	60	***41***	270000	4400	26
"	"	45-55	76370	1.33	57	0.00	25.86	74.14	65	***36***	270000	4300	27
"	"	55-65	76371	1.39	53	0.00	29.99	70.01	62	***40***	280000	4300	20
"	"	65-75	76372	1.39	53	0.00	23.46	76.54	60	***34***	280000	4200	18
"	"	75-85	76373	1.38	53	0.08	34.35	68.57	58	***30***	270000	4600	14
"	"	85-95	76374	1.42	48	0.00	22.63	77.37	48	***29***	280000	4600	14
"	"	95-105	76375	--	47	0.00	28.13	71.87	47	***25***	280000	4700	14
"	"	105-115	76376	--	47	0.00	25.83	74.17	49	***29***	270000	4600	13
"	"	Mean, 25-115 cm		1.37	53	0.02	28.59	71.72	57	***33***	274444	4467	20
15	97/06/04	0-5	76377	1.18	75	0.00	19.04	80.96	74	***46***	240000	4800	78
"	"	5-15	76378	1.27	68	0.00	22.29	77.71	70	***39***	230000	4800	58
"	"	15-25	76379	1.31	63	0.00	23.46	76.54	61	***36***	240000	4900	42
"	"	25-35	76380	1.34	57	0.00	28.92	71.08	61	***34***	250000	4700	29
"	"	35-45	76381	1.33	59	0.00	22.16	77.84	66	***37***	250000	4800	25
"	"	45-55	76382	1.37	54	0.00	22.44	77.56	60	***35***	260000	4800	20
"	"	55-65	76383	1.39	54	0.00	35.18	64.82	62	***34***	240000	5000	19
"	"	65-75	76384	1.43	50	0.00	28.50	71.50	51	***31***	260000	4700	11
"	"	75-85	76385	1.45	48	0.00	41.73	58.27	46	***38***	260000	4600	13
"	"	85-95	76386	--	49	0.00	38.40	61.60	48	***29***	260000	4600	12
"	"	95-105	76387	--	49	0.00	46.91	53.09	50	***33***	260000	4700	13
"	"	105-124	76388	--	51	0.00	24.21	75.79	56	--	250000	5100	13
"	"	Mean, 25-124 cm		0.75	52	0.00	32.05	67.95	56	***34***	254444	4778	17
5 & 15	Mean & Std. Dev'n., 25-124 cm			1.38 +/-0.04	53 +/-4.4	0.01 +/-0.03	30.32 +/-7.12	69.84 +/-7.06	56 +/-7.0	***32*** +/-8.9	264444 +/-11991	4622 +/-232	19 +/-6.9
PSQG-LEL				--	--	--	--	--	--	10	--	--	--
PSQG-SEL				--	--	--	--	--	--	1000	--	--	--
OWDMDG				--	--	--	--	--	--	--	--	--	--

NOTES: "<MDL" = less than method detection limit.
italicized and bolded values exceed PSQ-LEL guideline for the protection of sediment-dwelling organisms

Table E-2. Particle size, macro-ion, nutrient, organic carbon and solvent extractables concentrations in Lake Couchiching sediment cores.

Concentration units as noted: % = percent; g/kg = ppth; mg/kg = ppm. Except for particle size, all results are on dry weight basis

Station Number	Sample Date	Sediment Depth, cm	Field Sample Number	Nitrogen, total Kjeldahl, unf. react. g/kg		Phosphorus, unf. total g/kg		Sulphur, total g/kg		Solvent Extractables mg/kg		Total Petroleum Hydrocarbons, mg/kg	
5	97/06/04	0-5	76365	***4.0***		0.24		1.7		770		100	<MDL
"	"	5-15	76366	***2.9***		0.20		2.3		640		100	<MDL
"	"	15-25	76367	***3.0***		0.16		2.1		560		100	<MDL
"	"	25-35	76368	***2.6***		0.16		1.4		450		100	<MDL
"	"	35-45	76369	***2.7***		0.16		1.4		390		100	<MDL
"	"	45-55	76370	***2.9***		0.08		1.3		500		100	<MDL
"	"	55-65	76371	***2.4***		0.16		1.1		340		100	<MDL
"	"	65-75	76372	***2.8***		0.12		1.2		450		100	<MDL
"	"	75-85	76373	***2.6***		0.12		1.2		360		100	<MDL
"	"	85-95	76374	***2.1***		0.16		1.0		330		100	<MDL
"	"	95-105	76375	***1.8***		0.16		0.94		300		100	<MDL
"	"	105-115	76376	***1.7***		0.16		0.89		340		100	<MDL
"	"	Mean, 25-115 cm		***2.4***		0.14		1.2		384		100	<MDL
15	97/06/04	0-5	76377	***3.6***		0.32		1.3		410		100	<MDL
"	"	5-15	76378	***3.6***		0.20		2.0		390		100	<MDL
"	"	15-25	76379	***2.8***		0.18		1.4		420		100	<MDL
"	"	25-35	76380	***2.0***		0.16		1.1		360		100	<MDL
"	"	35-45	76381	***2.5***		0.16		1.1		390		100	<MDL
"	"	45-55	76382	***2.5***		0.16		1.1		420		100	<MDL
"	"	55-65	76383	***2.6***		0.12		1.1		260		100	<MDL
"	"	65-75	76384	***2.2***		0.16		0.96		300		100	<MDL
"	"	75-85	76385	***1.6***		0.16		0.84		240		100	<MDL
"	"	85-95	76386	***1.8***		0.16		0.76		240		100	<MDL
"	"	95-105	76387	***1.7***		0.12		0.87		270		100	<MDL
"	"	105-124	76388	***2.4***		0.16		1.0		360		100	<MDL
"	"	Mean, 25-124 cm		***2.1***		0.15		0.98		316		100	<MDL
5 & 15	Mean & Std. Dev'n., 25-124 cm			***2.3***	+/-0.4	0.15	+/-0.02	1.07	+/-0.18	350	+/-75	100	<MDL
PSQG-LEL:				0.55		0.60		--		--		--	
PSQG-SEL:				4.8		2.00		--		--		--	
OWDMDG:				--		--		--		1500		--	

NOTES: "<MDL" = less than method detection limit.

italicized and bolded values exceed PSQ-LEL guideline for the protection of sediment-dwelling organisms.

Table E3. Microscopic characteristics of Lake Couchiching sediment core samples

Number	Sample Date	Sediment Depth, cm	Field Sample Number	Silt & Clay (carbonates, quartz)	Clay (carbonates, quartz)	Biological Material (shell debris)	Vegetation Fibres
5	97/06/04	0-5	76365	90 %		10 %	Trace
"	"	5-15	76366	95 %		5 %	Trace
"	"	15-25	76367		95 %	5 %	Trace
"	"	25-35	76368		90 %	10 %	--
"	"	35-45	76369		100 %	Trace	--
"	"	45-55	76370		95 %	5 %	--
"	"	55-65	76371		90 %	5 %	--
"	"	65-75	76372		100 %	Trace	--
"	"	75-85	76373		100 %	Trace	--
"	"	85-95	76374		95 %	5 %	--
"	"	95-105	76375		100 %	Trace	--
"	"	105-115	76376		100 %	Trace	--
15	97/06/04	0-5	76377		100 %	Trace	Trace
"	"	5-15	76378		100 %	Trace	--
"	"	15-25	76379		95 %	5 %	--
"	"	25-35	76380		100 %	Trace	--
"	"	35-45	76381		95 %	5 %	--
"	"	45-55	76382		95 %	5 %	--
"	"	55-65	76383		90 %	10 %	--
"	"	65-75	76384		100 %	Trace	--
"	"	75-85	76385		100 %	Trace	--
"	"	85-95	76386		100 %	Trace	--
"	"	95-105	76387		100 %	Trace	--
"	"	105-124	76388		95 %	5 %	--

Note: no fossilized plants, wood bark chips, wood char or coal soot was found.

Table E-4. Inorganics and heavy metal concentrations in Lake Couchiching sediment core samples
All concentrations in mg/kg (ppm), dry weight.

Station Number	Sample Date	Sediment Depth, cm	Field Sample Number	Aluminum,	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese
5	97/06/04	0-5	76365	7200	0.6 <T	2.4	130	0.5 <=WE	***2.6***	24	5.4	14	8600	27	340
"	"	5-15	76366	7200	0.7 <T	3.9	130	0.5 <=WE	***1.2***	14	4.3	10	8600	23	320
"	"	15-25	76367	7600	0.4 <T	4.2	140	0.5 <=WE	***0.9*** <TE	14	6.7	8.0	9200	13	300
"	"	25-35	76368	7300	0.2 <=W	0.9 <T	140	0.5 <=WE	0.5 <TE	12	3.8	7.0	9000	2.0 <=WE	280
"	"	35-45	76369	7400	0.2 <=W	0.5 <T	130	0.5 <=WE	0.3 <TE	12	3.6	7.0	8900	2.0 <=WE	270
"	"	45-55	76370	6800	0.2 <=W	0.5 <T	130	0.5 <=WE	0.4 <TE	12	3.5	7.0	8300	4.0 <TE	260
"	"	55-65	76371	6700	0.2 <=W	0.5 <T	130	0.5 <=WE	0.4 <TE	11	3.6	6.0	8200	2.0 <=WE	280
"	"	65-75	76372	6200	0.2 <=W	0.4 <T	130	0.5 <=WE	0.5 <TE	11	3.6	6.0	7900	8.0 <TE	270
"	"	75-85	76373	6800	0.2 <=W	0.5 <T	130	0.5 <=WE	0.2 <=WE	11	3.6	7.0	8800	3.0 <TE	280
"	"	85-95	76374	7000	0.2 <=W	0.4 <T	130	0.5 <=WE	0.2 <=WE	12	3.7	6.0	9000	3.0 <TE	300
"	"	95-105	76375	6900	0.2 <=W	0.4 <T	140	0.5 <=WE	0.4 <TE	12	4.6	6.0	8900	5.0 <TE	300
"	"	105-115	76376	7100	0.2 <=W	0.4 <T	140	0.5 <=WE	0.3 <TE	12	4.0	7.0	9100	3.0 <TE	300
"	"	Mean, 25-115 cm		6911	0.2 <=W	0.5 <T	133	0.5 <=WE	0.3 <TE	12	3.8	6.6	8678	2.9 <TE	282
15	97/06/04	0-5	76377	8300	0.4 <T	2.2	140	0.5 <=WE	***0.7*** <TE	17	4.9	13	11000	***37***	400
"	"	5-15	76378	8300	0.5 <T	4.2	130	0.5 <=WE	***0.7*** <TE	16	4.6	10	11000	24	360
"	"	15-25	76379	8500	0.2 <=W	1.6	140	0.5 <=WE	***0.8*** <TE	15	4.9	8.0	12000	4.0 <TE	350
"	"	25-35	76380	8100	0.2 <=W	0.6 <T	140	0.5 <=WE	0.5 <TE	14	4.2	7.0	11000	4.0 <TE	340
"	"	35-45	76381	7800	0.2 <=W	0.5 <T	130	0.5 <=WE	***0.6*** <TE	13	4.8	7.0	11000	5.0 <TE	340
"	"	45-55	76382	7800	0.2 <=W	0.5 <T	130	0.5 <=WE	0.4 <TE	14	4.5	7.0	11000	5.0 <TE	350
"	"	55-65	76383	8100	0.2 <=W	0.5 <T	130	0.5 <=WE	0.5 <TE	15	4.8	7.0	12000	2.0 <=WE	350
"	"	65-75	76384	7500	0.2 <=W	0.4 <T	130	0.5 <=WE	0.3 <TE	13	4.7	6.0	11000	4.0 <TE	350
"	"	75-85	76385	7100	0.2 <=W	0.4 <T	140	0.5 <=WE	***0.7*** <TE	12	3.9	6.0	10000	6.0 <TE	350
"	"	85-95	76386	7400	0.2 <=W	0.3 <T	140	0.5 <=WE	***0.8*** <TE	13	4.4	7.0	10000	6.0 <TE	360
"	"	95-105	76387	7300	0.2 <=W	0.3 <T	140	0.5 <=WE	0.4 <TE	14	4.1	6.0	10000	3.0 <TE	360
"	"	105-124	76388	8100	0.2 <=W	0.5 <T	140	0.5 <=WE	0.3 <TE	15	4.8	8.0	12000	5.0 <TE	370
"	"	Mean, 25-124 cm		7689	0.2 <=W	0.4 <T	136	0.5 <=WE	0.5 <TE	14	4.5	6.8	10089	4.2 <TE	352
5 & 15	Mean & Std. Dev'n., 25-124 cm			7300 +/-602	0.2 +/-0	0.5 +/-0.2	134 +/-9.3	0.5 +/-0	0.4 +/-0.1	13 +/-1.2	4.1 +/-0.4	6.7 +/-1.0	9783 +/-784	4.0 +/-2.2	317 +/-23
PSQG-LEL:				–	–	6	–	–	0.6	26	–	16	20000	31	460
PSQG-SEL:				–	–	33	–	–	10	110	–	110	40000	250	1100
OWDMDG:				–	–	–	–	–	–	–	50	–	–	–	–

NOTES: blank or "–" indicates that data is not available for this parameter or sample.
"<T" = a measurable trace amount: interpret with caution.
"<=W" = no measurable response (zero): less than reported value.
"<=TE" = a measurable trace after extra dilution or concentration: caution.
"<=WE" = no measurable response after extra dilution or concentration: less than reported value.
italicized and bolded values exceed PSQ-LEL guideline for the protection of sediment-dwelling organisms.

Table E-4. Inorganics and heavy metal concentrations in Lake Couchiching sediment core samples

All concentrations in mg/kg (ppm), dry weight.

Station Number	Sample Date	Sediment Depth, cm	Field Sample Number	Mercury	Molybdenum	Nickel	Selenium	Strontium	Titanium	Vanadium	Zinc
5	97/06/04	0-5	76365	0.07	0.5 <=WE	13	0.4 <T	220	460	21	53
"	"	5-15	76366	0.05	0.5 <=WE	12	0.6 <T	220	470	15	45
"	"	15-25	76367	0.05	0.5 <=WE	9.8	0.3 <T	220	500	16	33
"	"	25-35	76368	0.04 <T	0.5 <=WE	7.9	0.3 <T	220	480	14	25
"	"	35-45	76369	0.04 <T	0.5 <=WE	8.3	0.3 <T	220	500	15	25
"	"	45-55	76370	0.04 <T	0.5 <=WE	7.3	0.3 <T	210	470	14	24 <TE
"	"	55-65	76371	0.03 <T	0.5 <=WE	6.6	0.3 <T	220	470	14	23 <TE
"	"	65-75	76372	0.03 <T	0.5 <=WE	7.6	0.3 <T	220	420	13	22 <TE
"	"	75-85	76373	0.04 <T	0.5 <=WE	7.2	0.3 <T	220	480	14	24 <TE
"	"	85-95	76374	0.04 <T	0.5 <=WE	7.1	0.3 <T	220	520	15	25
"	"	95-105	76375	0.04 <T	0.5 <=WE	7.9	0.3 <T	220	500	15	24 <TE
"	"	105-115	76376	0.04 <T	0.5 <=WE	8.0	0.3 <T	220	530	15	25
"	"	Mean, 25-115 cm		0.04 <T	0.5 <=WE	7.5	0.3 <T	219	486	14	24
15	97/06/04	0-5	76377	0.07	0.5 <=WE	14	0.8 <T	200	520	20	62
"	"	5-15	76378	0.07	0.5 <=WE	12	0.7 <T	200	560	19	47
"	"	15-25	76379	0.04 <T	0.5 <=WE	9.6	0.4 <T	200	560	18	32
"	"	25-35	76380	0.03 <T	0.5 <=WE	9.0	0.3 <T	200	560	17	29
"	"	35-45	76381	0.03 <T	0.5 <=WE	8.1	0.4 <T	200	540	17	30
"	"	45-55	76382	0.03 <T	0.5 <=WE	8.8	0.3 <T	210	550	17	30
"	"	55-65	76383	0.04 <T	0.5 <=WE	8.7	0.4 <T	200	600	18	30
"	"	65-75	76384	0.05	0.5 <=WE	9.1	0.3 <T	200	550	16	28
"	"	75-85	76385	0.03 <T	0.5 <=WE	8.3	0.3 <T	210	500	16	27
"	"	85-95	76386	0.04 <T	0.5 <=WE	8.5	0.3 <T	200	550	16	28
"	"	95-105	76387	0.04 <T	0.5 <=WE	8.6	0.3 <T	200	550	16	27
"	"	105-124	76388	0.03 <T	0.5 <=WE	10	0.4 <T	200	590	19	31
"	"	Mean, 25-124 cm		0.04 <T	0.5 <=WE	8.8	0.3 <T	202	554	17	29
5 & 15	Mean & Std. Dev'n., 25-124 cm			0.04 +/-0.01	0.5 +/-0	8.2 +/-0.8	0.3 +/-0.1	211 +/-3.3	520 +/-46	16 +/-1.4	27 +/-2.0
PSQG-LEL:				0.2	--	16	--	--	--	--	120
PSQG-SEL:				2.0	--	75	--	--	--	--	820
OWDMDG:				--	--	--	--	--	--	--	--

NOTES: blank or "--" indicates that data is not available for this parameter or sample.

"<T" = a measurable trace amount: interpret with caution.

"<=W" = no measurable response (zero): less than reported value.

"<=TE" = a measurable trace after extra dilution or concentration: caution.

"<=WE" = no measurable response after extra dilution or concentration: less than reported value.

Italicized and bolded values exceed PSQ-LEL guideline for the protection of sediment-dwelling organisms.

Appendix F

Appendix F - Surficial Sediment Data

List of Tables and Figures

Table F-1. Field observations of Lake Couchiching surficial sediment samples.

Station Number	Sample Date	Field Sample Number	Description	Odour	Fauna
1	97/05/29	76812	silty ooze & some hard clay; some organic matter	H_2S	amphipods, chironomid, damselfly, Dreissena, isopods, *Hexagenia*, mayfly, worm, crayfish; snail & clam shells
2	"	76813	silty ooze	H_2S	amphipods, chironomid, *Dreissena*, *Hexagenia*, leech, snails; snail shells
3	"	76814	silty ooze	H_2S	amphipods, chironomid, *Dreissena*, clam, *Hexagenia*, crayfish; snail shells
4	"	76815	silty ooze	H_2S	amphipods, caddis fly, chironomid, damselfly, *Dreissena*, *Hexagenia*, mayfly, snails; snail shells
5	"	76816	silty ooze	slight H_2S	chironomids, phantom midge, *Dreissena*, clam, *Hexagenia*, snails
6	"	76817	gray, silty ooze; tan surface layer	slight H_2S	chironomids, *Dreissena*, *Hexagenia*, worms; abundant snail shells
7	"	76818	gray silty ooze	slight to strong H_2S	caddis fly, chironomids, dragon fly, *Dreissena*, *Hexagenia*, mayfly, snails, crayfish
8	"	76819	gray silty ooze	none	amphipods, chironomid, clam, damselfly, *Dreissena*, fishfly, isopods, *Hexagenia*, leech, crayfish
9	"	76820-R	gray silty ooze	none	amphipods, chironomids, *Dreissena*, *Hexagenia*, mayfly, worm
"	"	76821-R	gray silty ooze	none	chironomid, clams, *Dreissena*
"	"	76822-R	gray silty ooze	H_2S	amphipod, chironomid, *Dreissena*
10	97/05/30	76826	gray silty ooze	none	amphipods, chironomids, dragon fly, *Dreissena*, *Hexagenia*, snails, worms, crayfish; abundant snail shells
11	"	76827	gray silty ooze	none	caddisfly, chironomids, dragon fly, *Dreissena*, *Hexagenia*, snails, worms, crayfish; abundant snail shells
12	"	76828	gray silty ooze	none to slight H_2S	amphipods, chironomids, clams, *Dreissena*, *Hexagenia*, mayfly; abundant snail shells
13	"	76829	brown silt over gray, sandy clay	none	amphipods, caddisfly, chironomids, clams, *Dreissena*, *Hexagenia*, leech; abundant snail shells
14	97/06/02	76831	gray silty ooze; abundant organic detritus (bark)	none	amphipods, chironomids, clams, dragonfly, *Dreissena*, mayfly, worms; snail shells
15	"	76830	gray silty ooze	none	chironomids, phantom midge, clams, *Dreissena*, *Hexagenia*; snail shells
16	"	76832	gray silty ooze	slight H_2S	amphipods, chironomids, damselfly, dragonfly, *Dreissena*, *Hexagenia*, mayfly, leech, snails; abundant snail shells
17	"	76833-R	gray silty ooze	none	chironomid, phantom midge, clams, *Dreissena*, *Hexagenia*; snail shells
"	"	76834-R	gray silty ooze	none	chironomid, phantom midge, clams, *Dreissena*, fishfly, *Hexagenia*; snail shells
"	"	76835-R	gray silty ooze	none	chironomid, phantom midge, clams, Dreissena, fishfly, Hexagenia; snail shells
18	97/05/29	76823	silty sand with some hard clay; abundant detritus	slight H_2S	amphipods, abundant chironomids, clams, *Dreissena*, isopod, mayfly, snail, worms
19	"	76824	gray silty ooze	H_2S	amphipods, chironomids, *Dreissena*, isopods, abundant snails, crayfish
20	"	76825	gray silty ooze	H_2S	chironomids, caddisfly, *Dreissena*, worms, crayfish
21	97/06/02	76836	gray silty ooze	H_2S	amphipods, chironomids, *Dreissena*, *Hexagenia*, mayfly, crayfish; abundant snail shells

NOTE: "-R" = field spatial replicate.

Table F-1. Field observations of Lake Couchiching surficial sediment samples.

Station Number	Sample Date	Field Sample Number	Station Number	Sample Date	Field Sample Number	Flora
1	97/05/29	76812	1	97/05/29	76812	calcified *Chara* (50% cover); *Elodea*; macrophyte tubers
2	"	76813	2	"	76813	*Chara* (30-40% cover); macrophyte tubers
3	"	76814	3	"	76814	heavily calcified *Chara* (100% cover)
4	"	76815	4	"	76815	calcified Chara (60% cover) & macrophyte tubers
5	"	76816	5	"	76816	absent to abundant filamentous algae
6	"	76817	6	"	76817	*Chara* (0-20 % cover); macrophyte tubers
7	"	76818	7	"	76818	heavily calcified *Chara* (95% cover); sparse *Myriophyllum* & macrophyte tubers; sparse globular colonial algae
8	"	76819	8	"	76819	calcified *Chara* (90% cover)
9	"	76820-R	9	"	76820-R	calcified *Chara* (90% cover)
"	"	76821-R	"	"	76821-R	calcified *Chara* (90% cover); sparse globular colonial algae
"	"	76822-R	"	"	76822-R	calcified *Chara* (90% cover)
10	97/05/30	76826	10	97/05/30	76826	calcified *Chara* (85% cover)
11	"	76827	11	"	76827	calcified *Chara* (95% cover)
12	"	76828	12	"	76828	calcified *Chara* (90-95% cover)
13	"	76829	13	"	76829	calcified *Chara* (70-80% cover)
14	97/06/02	76831	14	97/06/02	76831	*Chara* (90% cover); macrophyte tubers
15	"	76830	15	"	76830	none
16	"	76832	16	"	76832	*Chara* (70-80% cover); macrophyte tubers
17	"	76833-R	17	"	76833-R	none
"	"	76834-R	"	"	76834-R	none
"	"	76835-R	"	"	76835-R	none
18	97/05/29	76823	18	97/05/29	76823	*Chara* (20% cover), *Elodea* & *Lemna*; sparse algae
19	"	76824	19	"	76824	*Chara* (40% cover), sparse *Elodea*; common algae
20	"	76825	20	"	76825	calcified *Chara* (100% cover)
21	97/06/02	76836	21	97/06/02	76836	*Chara* (70% cover), macrophyte tubers

NOTE: "-R" = field spatial replicate. NOTE: "-R" = field spatial replicate.

Table F-2. Microscopic characteristics of Lake Couchiching surficial sediment samples.

Station Number	Sample Date	Field Sample Number	Sand,Silt & Clay (carbonates, quartz)	Biological Material (shell debris)	Vegetation Fibres	Fossilized Plant	Wood & Bark Chips	Wood Char	Coal Soot	Elemental Composition
1	97/05/29	76812	80 %	20 %	--	--	Trace	Trace	Trace	Ca > Fe, K, Si
2	"	76813	80 %	20 %	--	--	--	--	Trace	Ca > K, Si
3	"	76814	70 %	20 %	10 %	--	--	--	--	Ca > Fe, K, Si
4	"	76815	80 %	20 %	Trace	--	--	--	--	
5	"	76816	90 %	5 %	5 %	--	--	--	--	Ca > Fe, K, Si
6	"	76817	70 %	20 %	10 %	--	--	--	--	
7	"	76818	60 %	5 %	5 %	30 %	--	--	--	
8	"	76819	60 %	10 %	10 %	20 %	--	--	--	
9	"	76820	80 %	10 %	--	10 %	--	--	--	
"	"	76821	80 %	10 %	--	10 %	--	--	--	
"	"	76822	75 %	10 %	5 %	10 %	--	--	--	
10	97/05/30	76826	60 %	20 %	20 %	--	--	--	--	
11	"	76827	70 %	20 %	--	10 %	--	--	--	
12	"	76828	60 %	10 %	10 %	20 %	--	--	--	
13	"	76829	80 %	20 %	--	Trace	--	--	--	
14	97/06/02	76831	70 %	20 %	10 %	--	--	--	--	Ca > Al, Fe, K, Si
15	"	76830	90 %	10 %	--	--	--	--	--	Ca > Al, Fe, K, Si
16	"	76832	80 %	10 %	10 %	--	--	--	--	Ca, Fe, Si > Al, Cl, Mg, K
17	"	76833	100 %	Trace	--	--	--	--	--	Ca
"	"	76834	90 %	10 %	--	--	--	--	--	Ca > Al, Fe, K, Si
"	"	76835	90 %	10 %	Trace	--	--	--	--	
18	97/05/29	76823	70 %	20 %	10 %	--	Trace	--	--	
19	"	76824	50 %	40 %	10 %	--	--	--	--	
20	"	76825	60 %	10 %	10 %	20 %	--	--	--	
21	97/06/02	76836	70 %	20 %	--	10 %	Trace	--	--	

NOTE: "--" = not detected / not found.

IMPORTANT NOTE CONCERNING THE FOLLOWING PAGES

THE PAGES WHICH FOLLOW HAVE BEEN FILMED TWICE IN ORDER TO OBTAIN THE BEST REPRODUCTIVE QUALITY

USERS SHOULD CONSULT ALL THE PAGES REPRODUCED ON THE FICHE IN ORDER TO OBTAIN A COMPLETE READING OF THE TEXT.

REMARQUE IMPORTANTE CONCERNANT LES PAGES QUI SUIVENT

LES PAGES SUIVANTES ONT ÉTÉ REPRODUITES EN DOUBLE AFIN D'AMÉLIORER LA QUALITÉ DE REPRODUCTION

LES UTILISATEURS DOIVENT CONSULTER TOUTES LES PAGES REPRODUITES SUR LA FICHE AFIN D'OBTENIR LA LECTURE DU TEXTE INTÉGRAL

Table F-3. Macro-ion, nutrient, and oil and grease extractables concentrations in Lake Couchiching surficial sediment samples.

Concentration units as noted: % = percent; g/kg = ppth; mg/kg = ppm. Except for particle size, all results are on dry weight basis.

Station Number	Sample Date	Field Sample Number	Moisture %	Course Sand 2000-1000 um %	Sand 1000-63 um %	Silt& Clay <63 um %	Residue, total loss on ign. g/kg	Organic Carbon, total g/kg	Calcium, unf. total mg/kg	Magnesium, unf. total mg/kg	Chloride, aq. extr. mg/kg	Nitrogen, total Kjeldahl, unf. react. g/kg	Phosphorus, unf. total g/kg
1	97/05/29	76812	65	0.04	41.28	58.68	57	***32***	210000	7000	70	***0.7***	***0.84***
2	"	76813	71	0.43	33.23	66.34	72	***39***	290000	3600	88	***4.3***	0.36
3	"	76814	71	0.18	33.32	66.50	66	***37***	310000	3200	74	***4.3***	0.32
4	"	76815	70	0.04	31.97	67.99	73	***37***	260000	5400	73	***3.8***	0.36
5	"	76816	71	0.06	29.03	70.90	78	***39***	260000	4500	73	***3.9***	0.40
6	"	76817	58	0.03	38.34	61.62	50	***27***	190000	4400	37	***2.2***	0.32
7	"	76818	71	0.16	28.76	71.09	78	***42***	290000	3400	100	***4.7***	0.26
8	"	76819	57	0.10	43.51	56.39	41	***21***	140000	2800	56	***2.4***	***0.64***
9	"	76820-R	52	0.03	22.56	77.41	32	***19***	140000	3100	40	***1.8***	0.50
"	"	76821-R	56	0.00	16.56	83.44	38	***20***	150000	3400	45	***2.1***	0.50
"	"	76822-R	56	0.00	21.74	78.26	39	***25***	160000	3200	44	***2.3***	0.46
10	97/05/30	76826	39	0.00	66.17	33.83	18	***12***	77000	1700	31	***1.1***	***0.64***
11	"	76827	64	0.07	28.25	71.68	49	***31***	250000	3300	60	***2.6***	0.28
12	"	76828	65	0.25	28.97	70.78	48	***26***	260000	2900	53	***4.9***	0.36
13	"	76829	41	0.67	70.07	29.26	18	7.0	100000	1800	30	***2.7***	0.24
14	97/06/02	76831	64	0.56	55.58	43.87	67	***33***	170000	8100	63	***2.8***	0.40
15	"	76830	67	0.12	45.16	54.72	74	***41***	240000	4900	81	***1.0***	0.62
16	"	76832	66	0.13	32.72	67.15	67	***35***	270000	3500	83	***3.1***	0.46
17	"	76833-R	70	0.19	33.02	66.79	70	***37***	260000	4600	68	***3.8***	0.28
"	"	76834-R	69	0.00	28.15	71.85	67	***40***	260000	4700	70	***3.4***	0.34
"	"	76835-R	69	0.08	29.63	70.30	69	***35***	260000	4700	61	***3.4***	0.32
18	97/05/29	76823	38	0.13	89.28	10.58	18	***10***	280000	2500	25	***1.1***	***0.60***
19	"	76824	64	0.71	23.38	75.91	66	***36***	280000	4200	110	***4.7***	0.42
20	"	76825	66	0.19	32.11	47.70	55	***29***	170000	4800	64	***3.3***	0.56
21	97/06/02	76836	58	0.18	47.58	52.24	42	***29***	160000	4000	47	***4.3***	0.36
Mean & Std. Dev'n.			62 +/-10	0.17 +/-0.20	38.81 +/-17.01	61.01 +/-17.06	54 +/-19	***30*** +/-10	217480 +/-65857	3988 +/-1440	62 +/-22	***3.0*** +/-1.3	0.43 +/-0.15
PSQG-LEL:			--	--	--	--	--	10	--	--	--	0.55	0.60
PSQG-SEL:			--	--	--	--	--	100	--	--	--	4.8	2.00
OWDMDG:			--	--	--	--	--	--	--	--	--	--	--

NOTES: "<MDL" = less than method detection li,it

"-R" = field spatial replicate.

italicized and bolded values exceed Provincial Sediment Quality-LEL guideline for the protection of sediment-dwelling organisms or the Open Water Dredged Material Disposal Guideline; values in shaded cells exceed PSQ-SEL guideline.

Table F-3. Macro-ion, nutrient, and oil and grease extractables concentrations in Lake Couchiching surficial sediment samples.

Concentration units as noted: % = percent; g/kg = ppth; mg/kg = ppm. Except for particle size, all results are on dry weight basis.

Station Number	Sample Date	Field Sample Number	Moisture %	Coarse Sand 2000-1000 um %	Sand 1000-63 um %	Silt& Clay < 63 um %	Residue, total loss on ign g/kg	Organic Carbon, total g/kg	Calcium, unf total mg/kg	Magnesium, unf total mg/kg	Chloride, aq extr mg/kg	Nitrogen, total Kjeldahl, unf react g/kg	Phosphorus, unf total g/kg
1	97/05/29	76812	65	0.04	41.28	58.68	57	***32***	210000	7000	70	***0.7***	***0.84***
2	"	76813	71	0.43	33.23	66.34	72	***39***	290000	3600	88	***4.3***	0.36
3	"	76814	71	0.18	33.32	66.50	66	***37***	310000	3200	74	***4.3***	0.32
4	"	76815	70	0.04	31.97	67.99	73	***37***	260000	5400	73	***3.8***	0.36
5	"	76816	71	0.06	29.03	70.90	78	***39***	260000	4500	73	***3.9***	0.40
6	"	76817	58	0.03	38.34	61.62	50	***27***	190000	4400	37	***2.2***	0.32
7	"	76818	71	0.16	28.76	71.08	78	***42***	290000	3400	100	***4.7***	0.26
8	"	76819	57	0.10	43.51	56.39	41	***21***	140000	2800	56	***2.4***	***0.64***
9	"	76820-R	52	0.03	22.56	77.41	32	***19***	140000	3100	40	***1.8***	0.50
"	"	76821-R	56	0.00	16.56	83.44	38	***20***	150000	3400	45	***2.1***	0.50
"	"	76822-R	56	0.00	21.74	78.26	39	***25***	160000	3200	44	***2.3***	0.46
10	97/05/30	76826	39	0.00	66.17	33.83	18	***12***	77000	1700	31	***1.1***	***0.64***
11	"	76827	64	0.07	28.25	71.68	49	***31***	250000	3300	60	***2.6***	0.28
12	"	76828	65	0.25	28.97	70.78	48	***26***	260000	2900	53	***4.9***	0.36
13	"	76829	41	0.67	70.07	29.26	18	7.0	100000	1800	30	***2.7***	0.24
14	97/06/02	76831	64	0.56	55.58	43.87	67	***33***	170000	8100	63	***2.8***	0.40
15	"	76830	67	0.12	45.16	54.72	74	***41***	240000	4900	81	***1.0***	0.62
16	"	76832	66	0.13	32.72	67.15	67	***35***	270000	3500	83	***3.1***	0.46
17	"	76833-R	70	0.19	33.02	66.79	70	***37***	260000	4600	68	***3.8***	0.28
"	"	76834-R	69	0.00	28.15	71.85	67	***40***	260000	4700	70	***3.4***	0.34
"	"	76835-R	69	0.08	29.63	70.30	69	***35***	260000	4700	61	***3.4***	0.32
18	97/05/29	76823	38	0.13	89.28	10.58	18	***10***	280000	2500	25	***1.1***	***0.60***
19	"	76824	64	0.71	23.38	75.91	66	***36***	280000	4200	110	***4.7***	0.42
20	"	76825	66	0.19	52.11	47.70	55	***29***	170000	4800	64	***3.3***	0.56
21	97/06/02	76836	58	0.18	47.58	52.24	42	***29***	160000	4000	47	***4.3***	0.36
Mean & Std Dev'n			62 +/-10	0.17 +/-0.20	38.81 +/-17.01	61.01 +/-17.06	54 +/-19	***30*** +/-10	217480 +/-65857	3988 +/-1440	62 +/-22	***3.0*** +/-1.3	0.43 +/-0.15
PSQG-LEL			--	--	--	--	--	10	--	--	--	0.55	0.60
PSQG-SEL			--	--	--	--	--	100	--	--	--	4.8	2.00
OWDMDG			--	--	--	--	--	--	--	--	--	--	--

NOTES: "<MDL" = less than method detection limit

"-R" = field spatial replicate

italicized and bolded values exceed Provincial Sediment Quality LEL guideline for the protection of sediment-dwelling organisms or the Open Water Dredged Material Disposal Guideline; values in shaded cells exceed PSQ SEL guideline

Table F-3. Macro-ion, nutrient, and oil and grease extractables concentrations in Lake Couchiching surficial sediment samples.

Concentration units as noted: % = percent; g/kg = ppth; mg/kg = ppm. Except for particle size, all results are on dry weight basis.

Station Number	Sample Date	Field Sample Number	Sulphur, total g/kg	Solvent Extractables mg/kg	Light Petroleum Hydrocarbons, mg/kg	Heavy Petroleum Hydrocarbons, mg/kg
1	97/05/29	76812	4.4	***1500***	100 <MDL	100 <MDL
2	"	76813	3.3	***2200***	100 <MDL	100 <MDL
3	"	76814	2.8	***1800***	100 <MDL	100 <MDL
4	"	76815	3.9	***1700***	100 <MDL	100 <MDL
5	"	76816	1.6	1200	100 <MDL	100 <MDL
6	"	76817	2.1	700	100 <MDL	100 <MDL
7	"	76818	3.0	***1700***	100 <MDL	100 <MDL
8	"	76819	1.9	960	100 <MDL	100 <MDL
9	"	76820-R	1.8	770	100 <MDL	100 <MDL
"	"	76821-R	1.7	810	100 <MDL	100 <MDL
"	"	76822-R	2.1	800	100 <MDL	100 <MDL
10	97/05/30	76826	1.1	370	100 <MDL	100 <MDL
11	"	76827	2.6	940	100 <MDL	100 <MDL
12	"	76828	2.2	1000	100 <MDL	100 <MDL
13	"	76829	0.97	380	100 <MDL	100 <MDL
14	97/06/02	76831	3.2	1300	100 <MDL	100 <MDL
15	"	76830	1.4	940	100 <MDL	100 <MDL
16	"	76832	2.6	1300	100 <MDL	100 <MDL
17	"	76833-R	1.5	690	100 <MDL	100 <MDL
"	"	76834-R	1.5	810	100 <MDL	100 <MDL
"	"	76835-R	1.5	820	100 <MDL	100 <MDL
18	97/05/29	76823	1.2	380	100 <MDL	100 <MDL
19	"	76824	1.7	1300	100 <MDL	100 <MDL
20	"	76825	2.5	***1500***	100 <MDL	100 <MDL
21	97/06/02	76836	2.2	990	100 <MDL	100 <MDL
Mean & Std. Dev'n.			2.2 +/-0.87	1074 +/-469	100 <MDL	100 <MDL
PSQG-LEL:			--	--	--	--
PSQG-SEL:			--	--	--	--
OWDMDG:			--	1500	--	--

NOTES: "<MDL" = less than method detection limit.

"-R" = field spatial replicate.

Italicized and bolded values exceed Provincial Sediment Quality-LEL guideline for the protection of sediment-dwelling organisms or the Open Water Dredged Material Disposal Guideline; values in shaded cells exceed PSQ-SEL guideline.

Table F-4. Inorganics and heavy metal concentrations in Lake Couchiching surficial sediment samples.

All concentrations in mg/kg (ppm), dry weight.

Station Number	Sample Date	Field Sample Number	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury
1	97/05/29	76812	10000	0.8 <T	***9.5***	180	0.5 <=WE	***1.9***	***55***	21	***22***	16000	***58***	300	0.05
2	"	76813	3800	0.8 <T	2.8	130	0.5 <=WE	0.3 <TE	11	3.9	13	5300	***38***	210	0.04
3	"	76814	2900	0.3 <T	1.6	120	0.5 <=WE	***0.6*** <TE	8.0	2.6	8.0	4200	23	200	0.02
4	"	76815	3800	0.4 <T	2.2	110	0.5 <=WE	0.4 <TE	9.0	2.0 <TE	9.0	6100	27	230	0.02
5	"	76816	6700	0.5 <T	2.4	130	0.5 <=WE	***0.8*** <TE	16	3.1	12	8500	***38***	320	0.03
6	"	76817	3200	0.3 <T	1.9	80	0.5 <=WE	0.3 <TE	7.0	2.9	4.0 <TE	5400	14	180	0.02
7	"	76818	3200	0.3 <T	1.6	120	0.5 <=WE	0.5 <TE	7.0	1.6 <TE	7.0	4600	18	180	0.02
8	"	76819	3400	0.2 <=W	1.0	65	0.5 <=WE	0.3 <T	6.0	2.9	4.0 <T	5500	12	220	0.31
9	"	76820-R	3600	0.2 <=W	1.1	61	0.5 <=WE	0.3 <T	7.0	2.5	4.0 <T	5800	9.0 <T	200	0.01
"	"	76821-R	4000	0.2 <=W	1.1	66	0.5 <=WE	0.5 <T	8.0	2.4 <T	4.0 <T	6300	12	220	0.01
"	"	76822-R	3400	0.2 <=W	1.1	71	0.5 <=WE	0.2 <=WE	7.0	1.8 <TE	4.0 <TE	5600	9.0 <TE	200	0.01
10	97/05/30	76826	2700	0.2 <=W	0.7 <T	37	0.5 <=W	0.4 <T	6.0	2.1 <T	1.0 <=W	5400	9.0 <T	170	0.01
11	"	76827	3600	0.2 <=W	1.2	99	0.5 <=WE	0.3 <TE	7.0	1.7 <TE	5.0	6100	18	190	0.01
12	"	76828	2600	0.2 <=W	1.1	96	0.5 <=WE	0.4 <TE	6.0	1.5 <TE	3.0 <TE	4500	13	160	0.01
13	"	76829	2300	0.2 <=W	0.7 <T	40	0.5 <=W	0.2 <=W	5.0	1.3 <T	2.0 <T	4700	5.0 <T	140	0.01
14	97/06/02	76831	4000	0.3 <T	1.8	75	0.5 <=WE	0.4 <TE	8.0	2.0 <TE	6.0	7800	15	290	0.03
15	"	76830	8200	0.5 <T	2.1	130	0.5 <=WE	***0.7*** <TE	17	5.1	11	11000	***36***	400	0.04
16	"	76832	3200	0.2 <=W	1.3	110	0.5 <=WE	0.5 <TE	6.0	1.3 <TE	6.0	4800	13	210	0.02
17	"	76833-R	6500	0.4 <T	2.1	130	0.5 <=WE	***0.7*** <TE	13	3.0	10	8400	27	330	0.04
"	"	76834-R	6500	0.4 <T	2.2	130	0.5 <=WE	0.3 <TE	13	3.6	10	8400	27	330	0.03
"	"	76835-R	6700	0.3 <T	2.1	130	0.5 <=WE	0.4 <TE	13	3.9	10	8500	21	330	0.03
18	97/05/29	76823	5100	0.2 <=W	0.7 <T	54	0.5 <=WE	0.2 <=W	9.0	4.1	3.0 <T	9000	5.0 <T	140	0.01
19	"	76824	2900	0.3 <T	1.1	120	0.5 <=WE	0.4 <TE	7.0	1.8 <TE	8.0	4500	15	250	0.02
20	"	76825	4500	0.3 <T	1.6	83	0.5 <=WE	0.2 <=WE	10	4.2	7.0	7000	18	230	0.02
21	97/06/02	76836	2900	0.2 <=W	1.1	62	0.5 <=WE	0.2 <=WE	6.0	0.7 <TE	3.0 <TE	5500	14	180	0.01
Mean & Std. Dev'n.			4388 +/-1954	0.3 +/-0.2	1.8 +/-1.7	97 +/-35	0.5 <=WE	0.5 +/-0.3	11 +/-9.8	9.8 +/-3.8	7.0 +/-4.5	6756 +/-2805	20 +/-12	232 +/-69	0.02
PSQG-LEL:			--	--	6	--	--	0.6	26	--	16	20000	31	460	0.2
PSQG-SEL:			--	--	33	--	--	10	110	--	110	40000	250	1100	2.0
OWDMDG:			--	--	--	--	--	--	--	50	--	--	--	--	--

NOTES: blank or "--" indicates that data is not available for this parameter or sample.

"-R" = field spatial replicate.

"<T" = a measurable trace amount: interpret with caution.

"<=W" = no measurable response (zero): less than reported value.

"<=TE" = a measurable trace after extra dilution or concentration: caution.

"<=WE" = no measurable response after extra dilution or concentration: less than reported value.

italicized and bolded values exceed Provincial Sediment Quality Lowest Effect Level Guideline for the protection of sediment-dwelling organisms.

Table F-4. Inorganics and heavy metal concentrations in Lake Couchiching surficial sediment samples.
All concentrations in mg/kg (ppm), dry weight.

Station Number	Sample Date	Field Sample Number		Molybdenum		Nickel		Selenium		Strontium		Titanium		Vanadium		Zinc	
1	97/05/29	76812		1.5	<TE	***28***		0.7	<T	200		900		30		92	
2	"	76813	<T	1.0	<TE	7.5		0.9	<T	250		250		9.0		45	
3	"	76814	<T	0.5	<=WE	7.4		0.8	<T	260		190		8.0		32	
4	"	76815	<T	0.5	<=WE	8.4		0.8	<T	220		280		12		46	
5	"	76816	<T	0.5	<=WE	13		0.7	<T	220		420		16		55	
6	"	76817	<T	0.5	<=WE	5.3		0.4	<T	180		320		10		27	
7	"	76818	<T	0.5	<=WE	6.0		0.7	<T	230		200		8.0		32	
8	"	76819	<=W	0.5	<=W	4.3		0.3	<T	130		390		12		25	
9	"	76820-R	<=W	0.5	<=W	4.1		0.3	<T	130		490		12		22	<T
"	"	76821-R	<=W	0.5	<=W	5.3		0.3	<T	130		530		14		24	<T
"	"	76822-R	<=W	0.5	<=WE	4.9		0.4	<T	140		390		12		24	<TE
10	97/05/30	76826	<=W	0.5	<=W	3.4		0.2	<=W	74		570		13		15	<T
11	"	76827	<=W	0.5	<=WE	6.2		0.5	<T	220		400		13		26	
12	"	76828	<=W	0.5	<=WE	5.2		0.4	<T	220		270		10		20	<TE
13	"	76829	<=W	0.5	<=W	2.8		0.2	<=W	88		400		11		13	<T
14	97/06/02	76831	<T	0.8	<TE	7.1		0.5	<T	150		470		16		35	
15	"	76830	<T	0.5	<=WE	13		0.7	<T	200		550		21		61	
16	"	76832	<T	0.5	<=WE	5.5		0.6	<T	240		230		8.0		29	
17	"	76833-R	<T	0.6	<TE	9.9		0.5	<T	230		460		15		44	
"	"	76834-R	<T	0.5	<=WE	11		0.6	<T	230		450		16		45	
"	"	76835-R	<T	0.6	<TE	10		0.6	<T	230		490		16		45	
18	97/05/29	76823	<=W	0.5	<=W	5.8		0.2	<=W	35		640		19		23	<T
19	"	76824	<T	0.6	<TE	5.5		0.8	<T	250		200		8.0		31	
20	"	76825	<T	0.5	<=WE	6.8		0.4	<T	160		430		14		36	
21	97/06/02	76836	<=W	0.5	<=WE	4.5		0.3	<T	140		360		11		20	<TE
Mean & Std. Dev'n.			+/-0.01	0.6	+/-0.2	7.6	+/-5.1	0.5	+/-0.2	183	+/-62	411	+/-160	13	+/-4.9	35	+/-17
PSQG-LEL:				--		16		--		--		--		--		120	
PSQG-SEL:				--		75		--		--		--		--		820	
OWDMDG:				--		--		--		--		--		--		--	

NOTES: blank or "--" indicates that data is not available for this parameter or sample.
"-R" = field spatial replicate.
"<T" = a measurable trace amount: interpret with caution.
"<=W" = no measurable response (zero): less than reported value.
"<=TE" = a measurable trace after extra dilution or concentration: caution.
"<=WE" = no measurable response after extra dilution or concentration: less than reported value.
italicized and bolded values exceed Provincial Sediment Quality Lowest Effect Level Guideline for the protection of sediment-dwelling organisms.

Table F-5. Polycyclic aromatic hydrocarbons concentrations in Lake Couchiching surficial sediment samples.
All concentrations in ug/kg (ppb), dry weight.

Station Number	Sample Date	Field Sample Number	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(g,h,i)-perylene	Benzo(a)pyrene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene
1	97/05/29	76812	20 <=W	20 <=W	20 <=W	60 <T	140	100	120 <T	80 <T	80 <T	40 <=W	200	20 <=W	***240***	40
2	"	76813	20 <=W	20 <=W	20 <=W	40 <T	80 <T	40 <T	80 <T	80 <T	40 <T	40 <=W	120	20 <=W	120 <T	20
3	"	76814	20 <=W	20 <=W	20 <=W	20 <=W	40 <T	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	40 <T	20 <=W	80 <T	40
4	"	76815	20 <=W	20 <=W	20 <=W	20 <=W	60 <T	40 <T	40 <=W	40 <=W	40 <T	40 <=W	80 <T	20 <=W	80 <T	20
5	"	76816	20 <=W	20 <=W	20 <=W	20 <=W	60 <T	20 <=W	80 <T	40 <=W	20 <=W	40 <=W	40 <T	20 <=W	80 <T	20
6	"	76817	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	40 <=W	20
7	"	76818	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	40 <=W	20
8	"	76819	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	40 <=W	20
9	"	76820-R	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	40 <=W	20
"	"	76821-R	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	40 <=W	20
"	"	76822-R	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	40 <=W	20
10	97/05/30	76826	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	40 <=W	20
11	"	76827	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	40 <=W	20
12	"	76828	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	40 <=W	20
13	"	76829	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	40 <=W	20
14	97/06/02	76831	20 <=W	20 <=W	20 <=W	20 <=W	40 <T	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	40 <=W	20
15	"	76830	20 <=W	20 <=W	20 <=W	20 <=W	60 <T	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	40 <T	20 <=W	80 <T	20
16	"	76832	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	40 <=W	20
17	"	76833-R	20 <=W	20 <=W	20 <=W	20 <=W	40 <T	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	40 <=W	20
"	"	76834-R	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	40 <=W	20
"	"	76835-R	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	40 <=W	20
18	97/05/29	76823	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	40 <=W	40
19	"	76824	20 <=W	20 <=W	20 <=W	20 <=W	40 <T	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	40 <=W	40
20	"	76825	20 <=W	20 <=W	20 <=W	20 <=W	40 <T	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	40 <T	20 <=W	40 <=W	20
21	97/06/02	76836	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	40 <=W	20
PSQG-LEL:			--	--	220	320	--	240	170	370	340	60	750	190	200	--
PSQG-SEL:			--	--	370000	1480000	--	1340000	320000	1440000	460000	130000	1020000	160000	32000	--

NOTE: "<T" = a measurable trace amount: interpret with caution.
"<=W" = no measurable response (zero): less than reported value.
"-R" = field spatial replicate.
italicized and bolded values exceed Provincial Sediment Quality Lowest Effect Level Guideline for the protection of sediment-dwelling organisms.

Table F-5. Polycyclic aromatic hydrocarbons concentrations in Lake Couchiching surficial sediment samples.
All concentrations in ug/kg (ppb), dry weight.

Station Number	Sample Date	Field Sample Number	-	Phenan-threne		Pyrene		Total of 16 PAHs
1	97/05/29	76812	<T	80	<T	180		1320
2	"	76813	<=W	40	<T	100		760
3	"	76814	<T	20	<=W	40	<T	240
4	"	76815	<=W	40	<T	60	<T	400
5	"	76816	<=W	20	<=W	40	<T	300
6	"	76817	<=W	20	<=W	20	<=W	0
7	"	76818	<=W	20	<=W	20	<=W	0
8	"	76819	<=W	20	<=W	20	<=W	0
9	"	76820-R	<=W	20	<=W	20	<=W	0
"	"	76821-R	<=W	20	<=W	20	<=W	0
"	"	76822-R	<=W	20	<=W	20	<=W	0
10	97/05/30	76826	<=W	20	<=W	20	<=W	0
11	"	76827	<=W	20	<=W	20	<=W	0
12	"	76828	<=W	20	<=W	20	<=W	0
13	"	76829	<=W	20	<=W	20	<=W	0
14	97/06/02	76831	<=W	20	<=W	20	<=W	40
15	"	76830	<=W	20	<=W	40	<T	220
16	"	76832	<=W	20	<=W	20	<=W	0
17	"	76833-R	<=W	20	<=W	20	<=W	40
"	"	76834-R	<=W	20	<=W	20	<=W	0
"	"	76835-R	<=W	20	<=W	20	<=W	0
18	97/05/29	76823	<T	20	<=W	20	<=W	40
19	"	76824	<T	20	<=W	20	<=W	80
20	"	76825	<=W	20	<=W	40	<T	120
21	97/06/02	76836	<=W	20	<=W	20	<=W	0
PSQG-LEL:				560		490		4000
PSQG-SEL:				950000		850000		10000

NOTE: "<T" = a measurable trace amount: interpret with caution.
"<=W" = no measurable response (zero): less than reported value.
"-R" = field spatial replicate.
Italicized and bolded values exceed Provincial Sediment Quality Lowest Effect Level Guideline for the protection of sediment-dwelling organisms.

Table F-6. Polychlorinated dibenzo-p-dioxins and dibenzofurans in Lake Couchiching surficial sediment samples.

All concentrations in ng/kg (ppt), dry weight.

Station Number	Sample Date	Field Sample Number	TetraCDF		TetraCDD		PentaCDF		PentaCDD		HexaCDF		HexaCDD		HeptaCDF		HeptaCDD		OctaCDF	OctaCDD	2,3,7,8-TetraCDF	2,3,7,8-TetraCDD	1,2,3,7,8-PentaCDF
2	*	76813	19	(17)	1.0	<	32	(13)	5.6	(5)	23	(7)	24	(8)	17	(2)	59	(2)	13	150	2.6	1.0	1.4

Station Number	Sample Date	Field Sample Number	2,3,4,7,8-PentaCDF	1,2,3,7,8-PentaCDD	1,2,3,4,7,8-HexaCDF	1,2,3,6,7,8-HexaCDF	2,3,4,6,7,8-HexaCDF	1,2,3,7,8,9-HexaCDF		1,2,3,4,7,8-HexaCDF	1,2,3,6,7,8-HexaCDD	1,2,3,7,8,9-HexaCDD	1,2,3,4,6,7,8-HeptaCDF	1,2,3,4,7,8,9-HeptaCDF		1,2,3,4,6,7,8 HeptaCDD	Total 2,3,7,8-TetraCDD TEQ
2	*	76813	1.7	1.5	2.2	1.7	1.8	1.0	<	1.3	2.3	2.6	8.3	1.0	<	29	4.3

NOTE: "<" = not detected at indicated detection limit.

Table F-7. Organochlorine pesticides concentrations in Lake Couchiching surficial sediment samples.
All concentrations in ug/kg (ppb), dry weight

Station Number	Sample Date	Field Sample Number	Aldrin	alpha-BHC	beta-BHC	gamma-BHC	alpha-Chlordane	gamma-Chlordane	Dieldrin	p,p'-DDD	p,p'-DDE	o,p-DDT	p,p'-DDT	alpha-Endosulfan	beta-Endosulfan	Endosulfan sulphate	Endrin
1	97/05/29	76812	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
2	"	76813	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
3	"	76814	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
4	"	76815	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
5	"	76816	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
6	"	76817	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
7	"	76818	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
8	"	76819	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
9	"	76820-R	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
"	"	76821-R	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
"	"	76822-R	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
10	97/05/30	76826	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
11	"	76827	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
12	"	76828	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
13	"	76829	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
14	97/06/02	76831	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
15	"	76830	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
16	"	76832	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
17	"	76833-R	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
"	"	76834-R	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
"	"	76835-R	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
18	97/05/29	76823	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
19	"	76824	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
20	"	76825	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
21	97/06/02	76836	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	5 <=W	1 <=W	5 <=W	5 <=W	2 <=W	4 <=W	4 <=W	4 <=W
PSQG-LEL:			2	6	5	3	7 *	7 *	2	8	5	8 **	8 **	--	--	--	3
PSQG-SEL:			8000	10000	21000	-1000	6000 *	6000 *	91000	6000	19000	71000 **	71000 **	--	--	--	130000

NOTE: "<=W" = no measurable response (zero): less than reported value; "<T" = a measurable trace amount: interpret with caution.
"-R" = field spatial replicate.
"PSQG-LEL" & "PSQG-SEL" = Provincial Sediment Quality-Lowest Effect Level & Severe Effect Level guidelines for the protection of sediment-dwelling organisms.
' * ' = guideline is for sum of the two Chlordane isomers.
' ** ' = guideline is for sum of the two DDT isomers.

Table F-7. Organochlorine pesticides concentrations in Lake Couchiching surficial sediment samples.
All concentrations in ug/kg (ppb), dry weight

Station Number	Sample Date	Field Sample Number	Hepta-chlor	Hepta-chlor Epoxide	Metho-xychlor	Mirex	Oxy-chlor-dane
1	97/05/29	76812	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
2	"	76813	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
3	"	76814	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
4	"	76815	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
5	"	76816	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
6	"	76817	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
7	"	76818	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
8	"	76819	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
9	"	76820-R	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
"	"	76821-R	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
"	"	76822-R	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
10	97/05/30	76826	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
11	"	76827	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
12	"	76828	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
13	"	76829	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
14	97/06/02	76831	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
15	"	76830	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
16	"	76832	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
17	"	76833-R	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
"	"	76834-R	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
"	"	76835-R	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
18	97/05/29	76823	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
19	"	76824	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
20	"	76825	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
21	97/06/02	76836	1 <=W	1 <=W	5 <=W	5 <=W	2 <=W
PSQG-LEL:			--	5	--	7	--
PSQG-SEL:			--	5000	--	130000	--

NOTE: "<=W" = no measurable response (zero): less than reported value; "<T" = a measurable trace amount: interpret with caution.

"-R" = field spatial replicate.

"PSQG-LEL" & "PSQG-SEL" = Provincial Sediment Quality-Lowest Effect Level & Severe Effect Level guidelines for the protection of sediment-dwelling organisms.

' * ' = guideline is for sum of the two Chlordane isomers

' ** ' = guideline is for sum of the two DDT isomers

Table F-8. Chlorinated aliphatics, aromatics and biphenyls concentrations in Lake Couchiching surficial sediment samples.

All concentrations in ug/kg (ppb), dry weight

Station Number	Sample Date	Field Sample Number	Hexa-chloro-ethane	Hexa-chloro-butadiene	2,3,6-Trichloro-toluene	2,4,5-Trichloro-toluene	2,6,a-Trichloro-toluene	1,2,3-Trichloro-benzene	1,2,4-Trichloro-benzene	1,3,5-Trichloro-benzene	1,2,3,4-Tetrachloro-robenzene	1,2,3,5-Tetrachloro-robenzene	1,2,4,5-Tetrachloro-robenzene	Penta-chloro-benzene	Hexa-chloro-benzene	Octa-chloro-styrene	Total PCBs
1	97/05/29	76812	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
2	"	76813	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
3	"	76814	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
4	"	76815	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
5	"	76816	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
6	"	76817	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
7	"	76818	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
8	"	76819	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
9	"	76820-R	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
"	"	76821-R	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
"	"	76822-R	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
10	97/05/30	76826	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
11	"	76827	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
12	"	76828	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
13	"	76829	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
14	97/06/02	76831	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
15	"	76830	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
16	"	76832	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
17	"	76833-R	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
"	"	76834-R	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
"	"	76835-R	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
18	97/05/29	76823	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
19	"	76824	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
20	"	76825	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
21	97/06/02	76836	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	2 <=W	2 <=W	2 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	1 <=W	20 <=W
PSQG-LEL:			--	--	--	--	--	--	--	--	--	--	--	--	20	--	70
PSQG-SEL:			--	--	--	--	--	--	--	--	--	--	--	--	24000	--	530000

NOTE: "<=W" = no measurable response (zero): less than reported value; "<T" = a measurable trace amount: interpret with caution.

"-R" = field spatial replicate

Table F-9. Phenoxy acid herbicides and chlorinated phenols concentrations in Lake Couchiching surficial sediment samples.

All concentrations in ug/kg (ppb), dry weight.

Station Number	Sample Date	Field Sample Number	Dicamba	2,4-D	2,4-DB	2,4-D Propionic Acid	2,4,5-T	Picloram	Silvex	2,3,4-Trichlor-phenol	2,4,5-Trichlor-phenol	2,4,6-Trichlor-phenol	2,3,4,5-Tetrachloro-phenol	2,3,5,6-Tetrachloro-phenol	Penta-chloro-phenol
1	97/05/29	76812	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W
2	"	76813	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W
3	"	76814	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W
4	"	76815	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W
5	"	76816	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W
6	"	76817	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W
7	"	76818	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W
8	"	76819	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W
9	"	76820	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W
"	"	76821	--	--	--	--	--	--	--	--	--	--	--	--	--
"	"	76822	--	--	--	--	--	--	--	--	--	--	--	--	--
10	97/05/30	76826	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W
11	"	76827	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W
12	"	76828	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W
13	"	76829	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W
14	97/06/02	76831	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W
15	"	76830	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W
16	"	76832	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W
17	"	76833	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W
"	"	76834	--	--	--	--	--	--	--	--	--	--	--	--	--
"	"	76835	--	--	--	--	--	--	--	--	--	--	--	--	--
18	97/05/29	76823	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W
19	"	76824	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W
20	"	76825	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W
21	97/06/02	76836	100 <=W	100 <=W	200 <=W	100 <=W	50 <=W	100 <=W	50 <=W	10 <=W	20 <=W	10 <=W	10 <=W	5 <=W	5 <=W

NOTES: blank or "--" indicates that data is not available for this parameter or sample.

"<=W" = no measurable response (zero): less than reported value.

Appendix G

Appendix G - Phytoplankton Data

List of Tables

Table G-1. List of phytoplankton genera collected from Lake Couchiching during 1997.

Cyanophytes	**Chrysophytes**
Anabaena	Chromulina
Aphanothece	Chrysidiastrum
Chroococcus	Chrysocromulina parva
Microcystis	Chrysolykos
Oscillatoria	Chrysophyte unid.
	Chrysophyte unid.
Dinophytes	Chrysophyte unid.
Gymnodium	Codonocladium
Peridinium	Dinobryon
	Dinobryon cysts
Cryptophytes	Epipyxis
Cryptomonas	Kephyrion
Katablepharis	Mallomonas
Rhodomonas	Ochromonas
	Pseudokephyrion
Chlorophytes	Salpingoeca
Botryococcus	Spiniferomonas
Chlamydomonas	Uroglena
Chlorella	
Coelastrum	**Bacillariophytes**
Cosmarium	Achnanthes
Dictyosphaerium	Amphora
Gloecystis	Asterionella
Gloeotila	cocconeis
Golenkinia	Cyclotella
Green unid.	Cymbella
Micractinium	Diatoma
Oocystis	Fragilaria
Pediastrum	Navicula
Pedimonas	Nitzschia
Scenedesmus	Rhizoselenia
Stichococcus	Rhoicosphenia
Tetraedron	Stephanodiscus
	Synedra

Table G-2. Seasonal phytoplankton trends and comparative phytoplankton data between stations in Lake Couchiching

(a) Seasonal phytoplankton trends showing community composition for the (central) Station 5 in Lake Couchiching. 1997. Data are volumes of plankton (μm^3/ml x 1000)

Date	Cyano	Dino	Crypto	Eugleno	Chryso	Chloro	Bacill	Total
03-Jun-97	0	0	21	0	560	1	10	592
17-Jun-97	1	2	10	0	45	5	7	70
08-Jul-97	0	17	10	0	84	2	12	125
22-Jul-97	7	11	12	0	508	5	23	566
07-Aug-97	8	13	6	0	36	21	93	177
22-Aug-97	11	8	3	0	25	5	271	323
10-Sep-97	1	0	8	0	75	0	204	288
25-Sep-97	3	1	19	0	28	3	51	105
07-Oct-97	14	0	15	0	93	7	180	309
23-Oct-97	0	3	26	0	72	1	65	167

(b) Phytoplankton community composition as a percentage of total biovolume at Station 5, Lake Couchiching. 1997.

Date	Cyano	Dino	Crypto	Eugleno	Chryso	Chloro	Bacill	Total
03-Jun-97	0.0	0.0	3.5	0.0	94.6	0.2	1.7	100
17-Jun-97	1.4	2.9	14.3	0.0	64.3	7.1	10.0	100
08-Jul-97	0.0	13.6	8.0	0.0	67.2	1.6	9.6	100
22-Jul-97	1.2	1.9	2.1	0.0	89.8	0.9	4.1	100
07-Aug-97	4.5	7.3	3.4	0.0	20.3	11.9	52.5	100
22-Aug-97	3.4	2.5	0.9	0.0	7.7	1.5	83.9	100
10-Sep-97	0.3	0.0	2.8	0.0	26.0	0.0	70.8	100
25-Sep-97	2.9	1.0	18.1	0.0	26.7	2.9	48.6	100
07-Oct-97	4.5	0.0	4.9	0.0	30.1	2.3	58.3	100
23-Oct-97	0.0	1.8	15.6	0.0	43.1	0.6	38.9	100

(c) Seasonal euphotic zone, average algal composition from the four L. Couchiching stations. 1997. (Calculated from recombined samples between June 3 and (μm^3/mlx1000)

Station	Cyano	Dino	Crypto	Eugleno	Chryso	Chloro	Bacill	Total
Station 5	4.5	5.5	13.0	0.0	152.6	5.0	91.6	272.2
Station 12	3.0	5.0	3.0	0.0	51.0	5.0	25.0	92.0
Station 15	16.0	20.0	8.0	0.0	142.0	2.0	142.0	330.0
Station 21	2.0	8.0	11.0	0.0	74.0	2.0	43.0	140.0

(d) Seasonal euphotic zone, algal compostion as a % of total biovolume from the four Lake Couchiching Stations (Calculated from recombined samples between June 3 and Oct 23/97).

Station	Cyano	Dino	Crypto	Eugleno	Chryso	Chloro	Bacill	Total
Station 5	1.653196	2.020573	4.7759	0	56.06172	1.836885	33.65173	100
Station 12	3.26087	5.434783	3.26087	0	55.43478	5.434783	27.17391	100
Station 15	4.848485	6.060606	2.424242	0	43.0303	0.606061	43.0303	100
Station 21	1.428571	5.714286	7.857143	0	52.85714	1.428571	30.71429	100

Appendix H

Appendix H - Zooplankton Data

List of Tables

Table H-1. List of common limnetic zooplankton from Lake Couchiching, 1997.

Cladocerans

Acroperus harpae
Bosmina longirostris
Chydorus sphaericus
Daphnia galeata mendotae
Daphnia tetrocurva
Diaptomus birgeii
Bosmina coregonii
Holopedium gibberum

Calanoid Copepods

Calanoid copepodid
Leptodiaptomus minutus
Skistodiaptomus oregonensis
Epischura lacustris
Epischura lacustris copepodid
Calanoid nauplii

Cyclopoid Copepods

Cyclopoid copepodid
Diacyclops thomasii
Eucyclops serrulatus
Mesocyclops edax
Tropocyclops extensus
Cyclopoid nauplii

Dreissenidae (Bivalvia) = Zebra mussels

veliger larvae

Table H-2: The Seasonal zooplankton succession expressed as a biomass (mg/m^3), in Lake Couchiching. 1997.

Species	101	110	118	122	127	152	132	135	201	204	205	210	211	215	301	302	333	309	338	313	999
Date	Ac.Curv	Bo.Long	Ch.Sphae	Da.G.Men	Da.Retro	Dia.Birg	Bos.Core	Ho.Gibber	Cal.Cop	Le.Minut	Sk.Oregon	Ep.Lacus	Ep.Lac.Cp	Cal.Naup	Cycl.Cop	Di.Tho	Eu.Serrul	Me.Edax	T.Exteus	Cycl.Naup	Veliger
97-06-03	0	0.318	0.007	0	0	0	0	0	1.341	0.098	0	0	0	0.285	2.555	2.146	0	0	0	0.261	0
97-06-17	0	15.132	0.036	0.048	0	0	0	0	4.836	2.845	1.286	0.802	1.138	0.221	32.417	21.851	0	0	0.049	3.212	2.863
97-07-08	0	0.624	0.006	0.041	0	0.027	0	0	0.711	0	0	0	0	0.124	2.024	0	0.026	0.023	0.041	1.227	13.693
97-07-22	0.404	4.758	0.006	0.722	0	0	0	0	1.549	0.634	0.537	0.472	0.442	0.124	2.323	0.581	0	0	0.019	0.453	11.932
97-08-07	0	0.015	0	0.224	0.137	0.134	0	0	1.752	0.728	0.628	0	0	0.237	3.34	0.203	0	0.391	0.012	0.584	8.674
97-08-22	0	0.165	0	0.224	0.914	0.578	0.136	0.216	5.003	4.032	3.299	0.577	0.698	0.197	6.556	0.114	0	1.863	0.192	0.438	4.254
97-09-10	0	0.39	0	0.13	4.325	0.352	0	0.261	4.408	1.046	13.037	0.597	2.981	0.437	5.847	0.522	0	1.251	1.466	0.448	0.157
97-09-25	0	0.964	0	0.097	6.921	0.441	0	0.486	7.509	2.089	2.451	0	1.306	0.181	5.007	0.358	0	0.454	1.117	0.506	0.106
97-10-07	0	2.056	0	0.214	1.485	0	0	0.651	3.683	0.676	0.436	0	0.983	0.093	4.173	0.519	0	0.172	0.816	0.651	0.256
97-10-23	0	1.687	0	0.133	0.529	0.001	0	0.301	3.874	0.09	0.743	0	0	0.04	5.197	0.549	0	0	1.088	0.151	0

Table H-3: Seasonal zooplankton density trends (#/m3) from Lake Couchiching 1997.

Species	101	110	118	122	127	152	132	135	201	204	205	210	211	215	301	302	333	309	338	313	999
Date	Ac.Curv	Bo.Long	Ch.Sphae	Da.G.Men	Da.Retro	Dia.Birg	Bos.Core	Ho.Gibber	Cal.Cop	Le.Minut	Sk.Oregon	Ep.Lacus	Ep.Lac.Cp	Cal.Naup	Cycl.Cop	Di.Tho	Eu.Serrul	Me.Edax	T.Exteus	Cycl.Naup	Veliger
97-06-03	0.0	274.8	29.4	0.0	0.0	0.0	0.0	0.0	863.7	19.6	0.0	0.0	0.0	1531.1	2198.5	451.5	0.0	0.0	0.0	3808.2	0.0
97-06-17	0.0	20675.1	323.0	40.4	0.0	0.0	0.0	0.0	1615.2	726.9	201.9	40.4	646.1	2261.3	31658.7	6137.9	0.0	0.0	40.4	52656.8	4199.6
97-07-08	0.0	1803.0	78.4	19.6	0.0	39.2	0.0	0.0	901.5	0.0	0.0	0.0	0.0	1411.1	3174.9	0.0	9.8	9.8	39.2	21950.0	16305.7
97-07-22	41.1	4440.4	41.1	246.7	0.0	0.0	0.0	0.0	657.8	164.5	61.7	20.6	370.0	986.8	2549.1	123.3	0.0	0.0	20.6	5673.9	12170.1
97-08-07	0.0	33.5	0.0	83.8	67.0	83.8	0.0	0.0	1407.1	201.0	67.0	0.0	0.0	2211.1	4020.2	50.3	0.0	134.0	16.8	8509.3	9581.4
97-08-22	0.0	301.5	0.0	37.7	339.2	376.9	37.7	37.7	1733.7	1093.0	452.3	37.7	226.1	2110.6	4145.8	75.4	0.0	640.7	226.1	7010.1	4748.8
97-09-10	0.0	678.4	0.0	18.8	2713.6	301.5	0.0	150.8	1582.9	301.5	1582.9	75.4	1281.4	4221.2	4221.2	150.8	0.0	339.2	1620.6	8140.8	150.8
97-09-25	0.0	2261.3	0.0	75.4	3241.2	150.8	0.0	150.8	3165.9	603.0	263.8	0.0	452.3	1809.1	4447.3	113.1	0.0	150.8	1243.7	7010.1	75.4
97-10-07	0.0	3165.9	0.0	37.7	603.0	0.0	0.0	263.8	1733.7	169.6	56.5	0.0	527.6	678.4	4899.6	169.6	0.0	56.5	810.3	8216.2	301.5
97-10-23	0.0	3693.5	0.0	37.7	226.1	18.8	0.0	37.7	1582.9	18.8	75.4	0.0	0.0	150.8	5728.7	131.9	0.0	0.0	1055.3	2186.0	0.0

Table H-4: Seasonal zooplankton length (µm) trends in L. Couchiching. 1997.

Species	101	110	118	122	127	152	132	136	201	204	205	210	211	215	301	302	333	309	338	313	999
Date	Ac.Curv	Bo.Long	Ch.Sphae	Da.G.Men	Da.Retro	Dia.Birg	Bos.Core	Ho.Gibber	Cal.Cop	Le.Minut	Sk.Oregon	Ep.Lacus	Ep.Lac.Cp	Cal.Naup	Cycl.Cop	Di.Tho	Eu.Serrul	Me.Edax	T.Exteus	Cycl.Naup	Veliger
97-06-03	0.0	353.5	249.5	0.0	0.0	0.0	0.0	0.0	589.0	956.8	0.0	0.0	0.0	277.0	508.5	932.8	0.0	0.0	0.0	180.7	0.0
97-06-17	0.0	303.2	199.4	600.9	0.0	0.0	0.0	0.0	764.9	869.0	1039.0	1685.2	611.0	199.7	481.7	831.9	0.0	0.0	541.5	174.7	98.8
97-07-08	0.0	242.9	179.3	727.6	0.0	497.7	0.0	0.0	447.0	0.0	0.0	0.0	0.0	195.0	400.6	0.0	742.5	712.8	509.5	168.3	113.0
97-07-22	727.7	335.7	215.4	814.8	0.0	0.0	0.0	0.0	686.9	863.2	1204.2	1788.2	515.1	228.2	464.4	931.7	0.0	0.0	489.4	192.9	124.1
97-08-07	0.0	265.8	0.0	796.8	699.6	648.2	0.0	0.0	523.6	843.0	1235.6	0.0	0.0	215.6	442.6	881.0	0.0	772.2	442.1	181.5	118.7
97-08-22	0.0	285.9	0.0	1062.2	767.1	656.4	528.2	802.0	735.8	848.9	1120.5	1515.7	758.9	205.8	557.9	525.4	0.0	771.1	452.9	176.1	117.9
97-09-10	0.0	291.1	0.0	1118.6	636.0	597.7	0.0	538.5	730.8	827.1	1173.3	1010.7	633.6	215.3	513.7	812.6	0.0	834.0	478.3	166.2	131.2
97-09-25	0.0	258.0	0.0	619.9	708.2	816.7	0.0	599.6	688.4	825.2	1236.0	0.0	729.4	211.1	486.2	796.4	0.0	782.3	476.8	187.6	158.3
97-10-07	0.0	297.1	0.0	1046.0	725.9	0.0	0.0	593.5	660.6	876.2	1141.8	0.0	581.8	241.0	453.3	786.3	0.0	785.8	499.5	192.9	114.4
97-10-23	0.0	259.1	0.0	848.0	716.1	179.6	0.0	881.1	696.4	942.7	1263.2	0.0	0.0	328.5	453.2	887.7	0.0	0.0	498.7	178.8	0.0

Appendix I

Appendix I - Macroflora Data

List of Tables

Table I-1. Dominance of macroflora at each of the 21 water and sediment quality stations.

July 1997

Station	#1	#2	#3	#4
1	*Chara*	*Vallisneria*		
2	*Chara*	*Vallisneria*	*Utricularia*	
3	*Chara*	*Najas*	*Utricularia*	
4	*Chara*	*Vallisneria*	*Utricularia*	
5				*Spirogyra*
6	*Chara*	*Vallisneria*	*Potamogeton amphipolius.*	
7	*Chara*	*Najas*		
8	*Chara*	*Najas*	*Vallisneria*	
9	*Chara*	*Vallisneria*	*Elodea*	
10	*Chara*			
11	*Chara*	*Vallisneria*	*Utricularia*	
12	*Chara*	*Utricularia*	*Najas*	
13	*Chara*	*Najas*	*Utricularia*	
14	*Chara*	*Utricularia*	*Vallisneria*	
15				*Spirogyra*
16	*Chara*	*Najas*	*Vallisneria*	
17	*Chara*	*Vallisneria*	*Najas*	*Utricularia*
18	*Chara*	*Vallisneria*		*Spirogyra*
19	*Elodea*	*Vallisneria*	*Myriophyllum*	
20	*Chara*	*Vallisneria*		
21	*Chara*	*Vallisneria*		

August 1997

Station	#1	#2	#3	#4
1	*Chara*	*Vallisneria*		
2	*Chara*	*Vallisneria*	*Utricularia*	
3	*Chara*			
4	*Chara*			
5				
6	*Chara*	*Najas*		
7	*Chara*	*Vallisneria*		
8	*Chara*			
9	*Chara*			
10	*Chara*	*Spirygyra*		
11	*Chara*			
12	*Chara*			
13	*Chara*			
14	*Chara*			
15				
16	*Chara*	*Vallisneria*		
17	*Spirogyra/Cladophora*			
18	*Chara*			
19	*Elodea*	*Chara*	*Potamogeton richardsonii*	
20	*Chara*	*Vallisneria*		
21	*Chara*			

Appendix J

Appendix J - Benthic Macroinvertebrate Data, QA/QC Measures, and Detailed Statistical Analyses

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List of Tables and Figures

method using a Bray-Curtis distance measure.

Figure J-3. Scatterplots of Correspondence Analysis (CA) axis scores. Samples close together in (a) have similar benthic communities. In (b) taxa close together tended to be found at the same sites.

Figure J-4. Relationships between the first two ordination axes and depth, colour and secchi depth.

J.1 Introduction

This appendix provides details on sorting procedures, sorting efficiencey (QA/QC) and detailed statistical analysis. The results of statistical analysis are briefly described, and are elaborated upon in the main document. Field notes made during the collection of the benthic samples are given in Appendix K, while raw benthic macroinvertebrate data are provided in Appendix L.

J.2 Methods

Sample Processing and Identification

In the laboratory, all samples were stained with rose bengal dye to improve visibility of the preserved organisms and washed using a 200 μm mesh sieve to remove excess dye, preservative and debris. Samples were scanned under a binocular microscope at 6-12 x magnification to further improve visibility of benthic invertebrates. Benthos were removed from the debris and re-preserved in 70% ethanol until they were identified. Sorting efficiency was just over 94% (i.e., > 94% of the organisms in the samples were removed, Appendix J).

Many of the samples were split to reduce the time needed for sorting. In most cases, sorting required 3-4 hours to process at least ≥¼ of a sample, collecting at least 100 organisms (Griffiths, 1998). Splitting or sub-sampling was performed by volume during the washing process in the laboratory. Splitting by volume is relatively common (Marchant, 1989; Resh and McElravy, 1993; Reynoldson and Rosenberg, 1996), does not bias for specific taxa, has negligible effects on variance of total numbers within stations (Kilgour et al., 1995), and little effect on the ability to distinguish between different types of benthic communities (Reynoldson and Rosenbgerg, 1996).

Benthic invertebrates were identified following the standards described by the Ontario Ministry of Natural Resources (OMNR, 1985). Chironomids from each sample were sorted into like groups. A minimum of 10% of the organisms from each group were slide mounted in a clearing agent for identification. Up to 50 oligochaete worms from each sample were also slide mounted in a clearing agent for identification. The taxonomic keys used for the identification of benthos from Lake Couchiching are given in Appendix J. Identifications of oligochaete worms were confirmed by Dr. David Barton, University of Waterloo. All identified specimens as well as a reference collection were stored in 70% alcohol in glass vials with neoprene stoppers. Slide-mounted specimens are in labelled slide boxes. This material is available for review from the Ontario Ministry of the Environment, Southwest Region, London (B. Hawkins).

To ensure a high degree of efficiency in removing invertebrates from benthic samples collected from Lake Couchiching, Water Systems Analysts implemented a Quality Assurance/Quality Control (QA/QC) work program. Only one technician (Ms. Nell Farmer, M.Sc.) sorted benthos from the samples. Mr. Bill Morton performed the QA/QC checking. During initial sorting, samples were split into four parts (quarters). Benthic invertebrates were removed from each quarter until approximately three hours had elapsed. During sorting, large organisms were removed first, and the sample was scanned under a stereo microscope at 6-12 x magnification. The numbers of organisms sorted from the debris was recorded. During re-

sorting (QA/QC checking), sub-samples that had been processed were re-processed as if it was the first time. The numbers of organisms found in the re-sorted samples was recorded.

Data Analysis

Analysis and interpretation of the benthic community in Lake Couchiching had two general objectives:

1. to establish trophic condition of the lake; and,
2. to determine the degree to which local point sources, and natural features and anthropogenic features influence benthic community composition.

To establish the trophic condition of the lake, we followed Saether's (1979) interpretations of sublittoral and profundal chironomid communities. We also compared observed total abundances in Lake Couchiching with abundances from lakes with known trophic status.

To achieve the second objective, we analyzed the benthic data using a two-step approach. The first step involved the calculation of summary metrics and examining the spatial variations of those metrics. The metrics included:

1 total abundance,
2 total number of taxa,
3 Shannon's H' (Shannon and Weaver, 1949)

$$H' = \sum p_i \log_2 p_i \qquad [1]$$

where, p_i refers to the proportion of the total numbers accounted for by the ith taxon; and,

4 Evenness, J' (Price, 1973)

$$J' = \frac{H'}{H'_{max}} \qquad [2]$$

where, H' is Shannon's H', and H'_{max} is the maximum possible H'.

The second step involved detailed multivariate analyses to more fully explore variations in composition and to explore the relationships between benthic community composition and physico-chemical properties at each of the stations.

Multivariate methods used to examine spatial variations in benthic community composition, included clustering and ordination techniques. Cluster analyses included the complete-linkage method, the flexible-clustering method (with beta set equal to -1), the single-linkage method, the unweighted pair-group method using an arithmetic average (UPGMA), the unweighted pair-group method using a centroid average (UPGMC), the weighted pair-group method using an arithmetic average (WPGMA), and the weighted pair-group method using a centroid average (WPGMC). Cluster analyses were performed on both a Bray-Curtis distance measure and a Jaccard's Coefficient of Community (Rohlf, 1993). For each cluster result, we examined

the correlation between the cophenetic matrix based on the cluster dendrogram and the original distance matrix (i.e., Bray-Curtis distance measure or the Jaccard Coefficient). Such cophenetic correlations can be used as a measure of the goodness of fit of a cluster analysis (Rohlf, 1993). In this analysis, the complete linkage method provided strong correlations with both the $\log_{10}$ transformed (Bray-Curtis) and presence/absence data (Jaccard Coefficient; Table 3). As such, these dendrograms were examined for spatial pattern.

In addition to the cluster analyses, we also used ordination (Correspondence Analysis, CA) to portray similarities among stations. Of the available methods, CA was selected because it gives an ordination of both taxa and stations so that it is readily possible to identify those taxa that are important to the patterns among stations. Although not presented here, other ordinations (Principal Components, Non-Metric Multidimensional Scaling) demonstrated similar relationships among stations. To portray spatial variations in community composition, we plotted the first two ordination axes from CA in a two-dimensional scatterplot.

Associations between benthic community composition and measured environmental conditions were determined in three stages. Mantel's (1967) test was used for the first stage to evaluate the concordance (correlation) between distance matrices based on faunal composition and physico-chemical properties at each station. Euclidean and Bray-Curtis distance matrices were calculated using average taxa abundances at each of the 21 stations, and using both raw and $\log_{10}$ abundances. Euclidean distances were calculated based on suites of environmental variables that included: (1) depth, (2) water column metal concentrations, (3) water column nutrient and major ion concentrations, (4) water column physical and biological characteristics, (5) concentrations of organic contaminants in the water column, (6) sediment physical features (particle size), (7) concentrations of solvent extractables in sediments, (8) concentrations of metals in sediments, (9) concentrations of nutrients and major ions in sediments, and (10) sediment organic content.

With Mantel's (1967) test, concordance between two matrices is measured as a summation of the cross-products between the off-diagonal elements of the two matrices. The degree of association of the two matrices is then judged against a null distribution determined via permutation. Because the Mantel statistic operates like a coefficient of determination (i.e., r^2, K.M. Somers, pers. comm.), Mantel *r* values indicate approximately, the amount of variation in one matrix explained by another.

In the second stage of the multivariate analysis, we used simple correlation analysis with scatterplots to determine the strength and nature of the relationships between the measured environmental variables and ordination axes that characterized variations in benthic community composition in Lake Couchiching. In this analysis, we used a subset of environmental variables against which to explore associations. Based on the Mantel correlations, it was apparent that depth, physical and biological characteristics of the water column and sediment metal concentrations explained significant amounts of spatial variation in benthic community composition (Table J-1). Rather than correlate all of the water physico-biological and sediment metal variables with benthic ordination axes, we selected those variables most strongly

associated with spatial patterns in environmental conditions. This selection process was based on a principal components analysis (PCA) of the physical and biological water data, and sediment metal data PCA (Table J-2). There was a single dominant gradient in the sediment metal concentrations primarily explained by high to low concentrations of iron. In the physical and biological water column data, secchi depth and colour were correlated with the two dominant gradients (PCA axes). Water depth, sediment-iron levels, secchi depth and colour were used as explanatory environmental variables in the correlation analyses.

J.3 Results

A total of 10 of the 63 (16%) benthic samples from Lake Couchiching were resorted. Subsampling errors ranged from 0 to 9.9% and averaged 5.9%. Therefore, over 94% of benthic organisms were recovered during sorting (Table J-3).

Spatial variation in benthic community composition in Lake Couchiching was significant. Figures J-1 and J-2 show this spatial variation in cluster dendrograms, while Figure J-3 shows the associations among stations based on an ordination (correspondence analysis). In general, the three figures were consistent in demonstrating the separation of Stations 5, 6, 15, 17, 18 and 19 from all other stations. Stations 5, 15 and 17 were the deep-water stations in the middle of the lake. Depth was correlated with the dominant gradient in benthic community composition (Table J-4, Figure J-4). The deep-water Stations (5, 15 and 17) had benthic communities with higher proportions of the phantom midge *Chaoborus punctipennis*. Two of these stations (5 and 15) also tended to have higher proportions of sphaeriid clams (*Pisidium*), the snail *Helisoma anceps* and the chironomid *Paracladopelma* (Figure J-3, Table J-5). Station 19, a shallow station (1.7 m) near the inflow from Lake Simcoe had a unique fauna that consisted of relatively high proportions of isopods (*Lirceus lineata, Caecidotea racovitzae*), snails (*Viviparous georgianus*) and worms (*Limnodrilus clarapedianus*) (Figure J3, Table J-5). Although the major gradient in benthic community composition was associated with depth, the secondary gradient in benthic community composition (CA Axis 2) was associated with colour (Table J-4, Figure J-4).

The dominant chironomid taxa in both shallow and deep water are given in Table J-6. A variety of sensitive Orthocladiinae were present in the lake including *Epoicocladius* and *Thienemanniella*. More tolerant chironomids included representatives of the Chironomini (*Chironomus, Dicrotendipes, Paratendipes*), Tanytarsini (*Cladotanytarsus, Tanytarsus*) and Tanypodinae (*Procladius*).

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Table J-1. Mantel correlations between Euclidean and Bray-Curtis distance of raw and log transformed benthic community data and Euclidean distance matrices of suites of environmental descriptors. Sample size is n=21. Probability of no significant positive association is given in parenthesis and is based on randomization. Significant positive correlations are in bold font.

	Distance Matrix	Date	Euclidean Distance		Bray-Curtis Distance Matrix	
			Raw Data	Logged	Raw Data	Logged
-1	Sediment metals	June 2-3	0.034 (0.284)	**0.367**	0.252 (0.108)	**0.323 (0.041)**
-2	Sediment particle size	June 2-3	0.185 (0.158)	0.136 (0.175)	0.126 (0.226)	0.078 (0.316)
-3	Sediment major ions	June 2-3	0.079 (0.186)	0.139 (0.090)	-0.186 (0.980)	-0.179 (0.962)
-4	Sediment loss on ignition	June 2-3	0.031 (0.305)	-0.031 0.446)	0.017 (0.403)	-0.033 (0.461)
-5	Sediment TPH and oil & grease	June 2-3	-0.033 (0.505)	0.012 (0.438)	-0.011 (0.503)	-0.007 (0.526)
-6	Depth	June 2-3	0.135 (0.161)	**0.415 (0.01)**	**0.461 (0.01)**	**0.614 (0.00)**
		July 7-8	0.132 (0.17)	**0.409 (0.01)**	**0.458 (0.02)**	**0.612**
-7	Water metals	June 2-3	-0.006 (0.543)	0.216 (0.053)	0.045 (0.359)	0.050 (0.356)
		July 7-8	-0.134 (0.849)	-0.174 (0.827)	-0.194 (0.934)	-0.187 (0.898)
-8	Water major ions	June 2-3	-0.107 (0.210)	-0.200 (0.043)	0.079 (0.745)	0.135 (0.868)
		July 7-8	-0.034 (0.566)	0.100 (0.754)	-0.113 (0.719)	-0.036 (0.516)
-9	Water physical features	June 2-3	0.168 (0.167)	**0.562 (0.001)**	**0.574 (0.002)**	**0.677 (0.001)**
		July 7-8	0.195 (0.119)	**0.465 (0.001)**	**0.672 (0.002)**	**0.627 (0.001)**
-10	Water Atrazine	June 2-3	-0.002 (0.553)	-0.018 (0.611)	-0.046 (0.759)	-0.023 (0.588)

Table J-2. Principal components analysis of physico-biological data and sediment metal concentrations.

Sediment Metals				Physico-Biological (June 3)						
					June 2-3			35983		
Variable	1	2	3	Variables	1	2	3	1	2	3
Aluminum	0.58	0.81	0.12	Secchi Depth	**0.93**	0.09	0.15	**0.95**	0.26	0.13
Barium	0	0	-0.25	Colour	-0.1	-0.68	0.73	-0.26	**0.96**	0.05
Chromium	0	0	0	Tubidity	0	0	-0.1	0.08	0	0.04
Cobalt	0	0	0	Chl *a*	0.17	-0.73	-0.66	0.12	0.08	-0.99
Copper	0	0	0							
Iron	**0.82**	0.56	-0.12							
Lead	0	0	-0.1							
Manganese	0	0.1	-0.1							
Mercury	0	0	0							
Nickel	0	0	0							
Selenium	0	0	0							
Strontium	0	0.1	-0.54							
Titanium	0	-0.1	0.77							
Vanadium	0	0	0.01							
Zinc	0	0	-0.1							
Variance	97.7	2.2	0.06		72.3	15.2	9.9	64.2	30.9	3.11

Table J-3. Benthic QA/QC results

Station	1	3	4	5	7	7	7	12	18	20		
Replicate	2	3	1	3	1	2	3	2	2	3		
Date	97.05.28	97.05.28	97.05.28	97.05.28	97.05.29	97.05.29	97.05.29	97.05.30	97.05.29	97.05.29		
TAXA												
ANNELIDA:									5			
OLIGOCHAETA:			8									
AMPHIPODA:		5	4		8	3	10	1				
ISOPODA:									1			
DIPTERA:												
Chaoboridae:				2								
Chironomidae:		7	4	1	5	7	11	3	6			
EPHEMEROPTERA:	2			1	2	2	1		1			
TRICHOPTERA:			1									
MOLLUSCA:												
Dreissena		2	1		5							
Sphaeriidae:				2								
PLATYHELMINTHES			1				2					
No. in resort(A)	2	14	19	3	20	12	23	4	13	0		
No. in original sample(B)	48	306	276	97	181	121	223	196	141	268		
Total specimens(A+B)	50	320	295	103	201	133	246	200	154	268		
% error((A/A+B)X 100)	4	4.4	6.4	4.2	9.9	9	9.3	2	8.4	0	average	5.76
Resorted 10/63 samples = 16%												
Original Sort Technician: Nell Farmer			QC Technician: W. B. Morton									
1997.12.16												

Table J-4. Correlations among community descriptors and selected environmental variables.

	CA Axis 1	CA Axis 2	CA Axis 3	Secchi	Colour	Iron	Depth
CA Axis 1	1.00						
CA Axis 2	-0.03	1.00					
CA Axis 3	-0.04	0.05	1.00				
Secchi	-0.85	0.09	0.34	1.00			
Colour	-0.01	-0.65	-0.30	-0.12	1.00		
Iron	-0.41	-0.10	-0.01	0.32	0.30	1.00	
Depth	-0.94	0.02	0.29	0.96	-0.05	0.39	1

	CA Axis 1	CA Axis 2	CA Axis 3	Secchi	Colour	Iron	Depth
CA Axis 1	1.00						
CA Axis 2	-0.10	1.00					
CA Axis 3	0.09	-0.05	1.00				
Secchi	0.53	-0.70	0.50	1.00			
Colour	-0.51	-0.35	-0.24	-0.12	1.00		
Iron	0.14	-0.41	0.09	0.32	0.30	1.00	
Depth	0.51	-0.80	0.44	0.96	-0.05	0.39	1.00

Table J-5. Average % abundances of major taxonomic benthic groups at each of the 21 benthic sampling stations in Lake Couchiching on May 29, 1997.

Major Group	Station																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Hirudinea	<1	<1	<1	<1		<1	<1	<1	<1		<1					<1			1	<1	
Oligochaeta	1	2	<1	3	1	6	<1	<1	<1	1	1		<1	5	6			7	2	1	2
Acari	1		<1	1	<1	<1	1	1	1	<1	1		<1	<1		1	2	<1	<1	1	<1
Chydoridae				2																	
Amphipoda	37	15	38	20		1	26	37	24	20	22	25	23	8	<1	23	2	2	30	36	11
Decapoda			<1					<1				<1									<1
Isopoda	3	1						<1										2	5	<1	
Elmidae (beetles)					<1																
Ceratopogonidae		<1		1	1		<1	<1	1	1	1	1	1	1		1	1			<1	1
Chaoboridae			<1		2				<1						8		2				
Chironomidae	30	19	17	29	16	21	28	27	24	12	31	38	18	23	10	46	35	74	3	23	26
Empididae							<1	<1											<1		
Ephemeroptera	15	1	2	1	2	17	14	7	6	1	16	4	8	1	5	9	21	6		2	12
Megaloptera														<1			1				<1
Odonata	1		<1				<1	<1	<1		<1			<1		1			<1		
Trichoptera	2	1	1	3		1	1	1	<1	2	1	1	1	1		1		<1	<1	1	1
Dreissenidae	9	47	35	24	64	47	22	20	35	62	22	27	45	59	40	14	31	1	45	31	42
Sphaeriidae	<1				4	2		<1	<1	1		<1	<1		6	<1	1	1			<1
Unionidae													<1		<1						
Gastropoda	1	13	4	16	12	4	5	5	7	1	4	4	3	2	24	4	1	5	14	3	4
Nematoda	1	1		<1									<1		2		3	<1		<1	
Platyhelminthes	<1		<1			<1	<1	<1		<1		<1	1	1	<1		1		<1	1	
Total Number of Taxa	23	20	20	29	18	14	21	28	25	23	24	21	23	24	19	22	14	19	19	25	24
Total Number of Specimens	36974	42840	50839	52439	48825	7229	31049	59668	46247	62216	38574	40826	36737	98005	15376	46751	5422	22753	34959	36678	25775
H'	3.01	2.70	2.46	3.68	1.98	2.60	3.19	3.11	2.92	1.98	3.31	3.21	2.79	2.38	2.78	3.41	2.67	2.65	2.63	2.91	3.12
Evenness	0.67	0.63	0.58	0.76	0.49	0.68	0.73	0.65	0.64	0.45	0.73	0.74	0.62	0.52	0.66	0.77	0.72	0.62	0.62	0.63	0.68

Table J-6 . Percentage composition of profundal and sublittoral chironomid communities.

Chironomid taxon	profundal	sublittoral
Chironomus	12	5
Cladotanytarsus	9	3
Cryptochironomus	1	1
Dicrotendipes	4	26
Microtendipes		<1
Parachironomus		<1
Paracladopelma	1	<1
Paratanytarsus		2
Paratendipes	7	20
Phaenopsectra flavipes		<1
Polypedilum	2	3
Pseudochironomus		2
Stempellina	1	1
Tanytarsus	35	9
Tribelos jucundum	2	6
Zavreleilla		<1
ORTHOCLADIINAE:		
Cricotopus		2
Epoicocladius	<1	<1
Psectrocladius	2	3
Thienemanniella		<1
TANYPODINAE:		
Ablabesmyia	4	8
Clinotanypus pinguis		1
Procladius	21	7

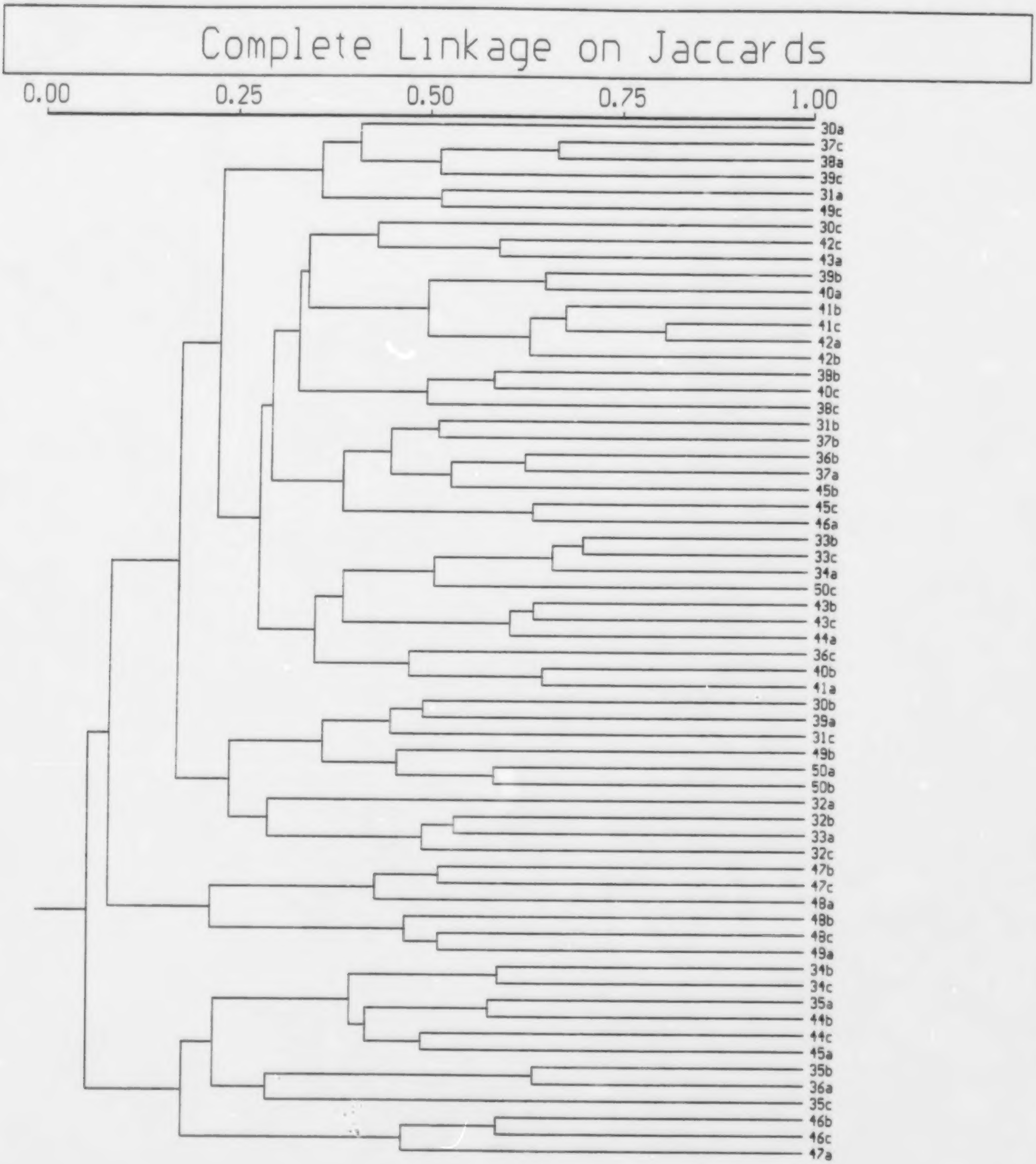

Figure J-1. Dendrogram showing the similarities in benthic community composition among stations in Lake Couchiching. Dendrogram was based on a complete linkage method using a Jaccards coefficient of community.

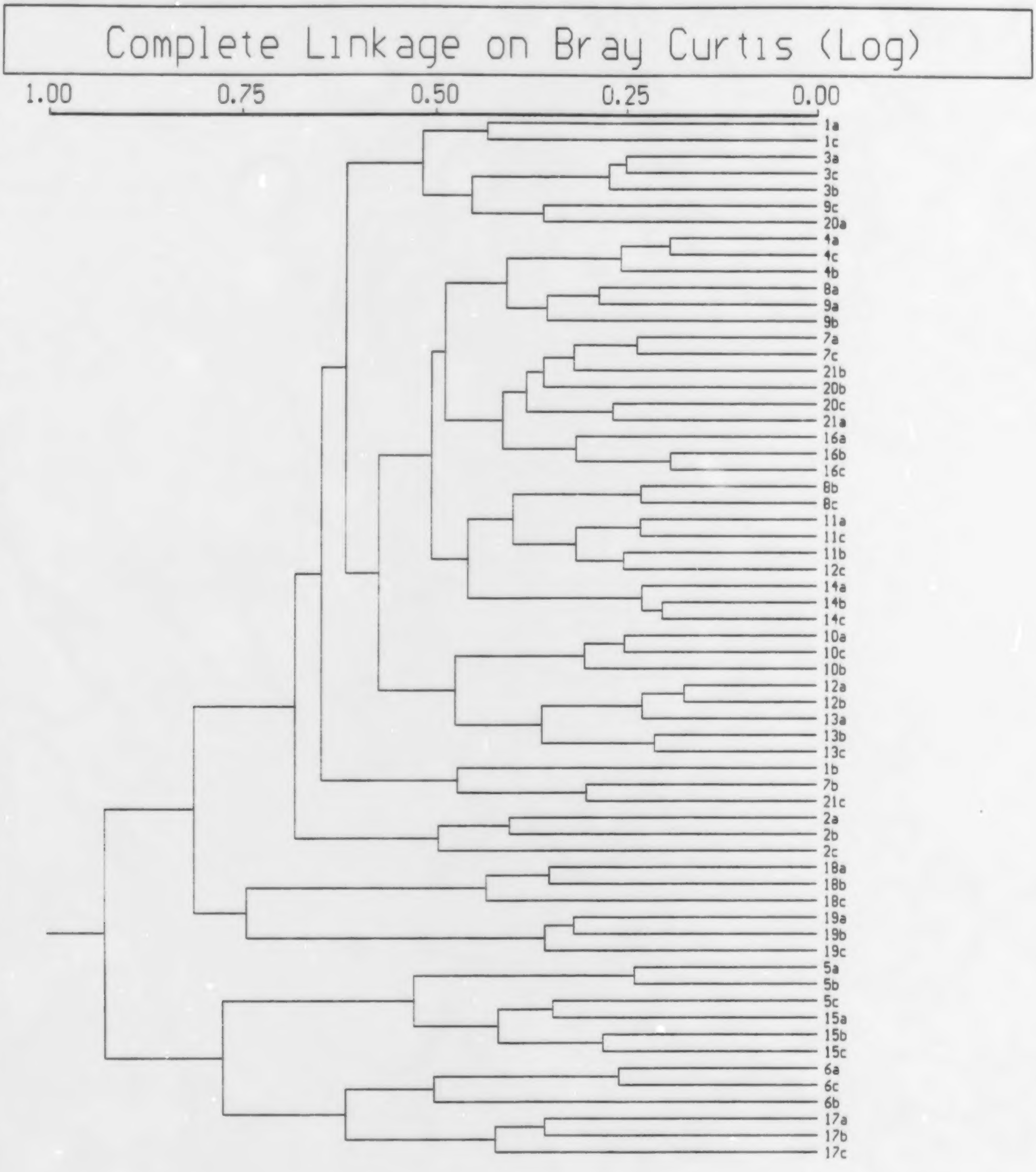

Figure J-2. Dendrogram showing the similarities in benthic community composition among stations in Lake Couchiching. Dendrogram was based on a complete linkage method using a Bray-Curtis distance measure.

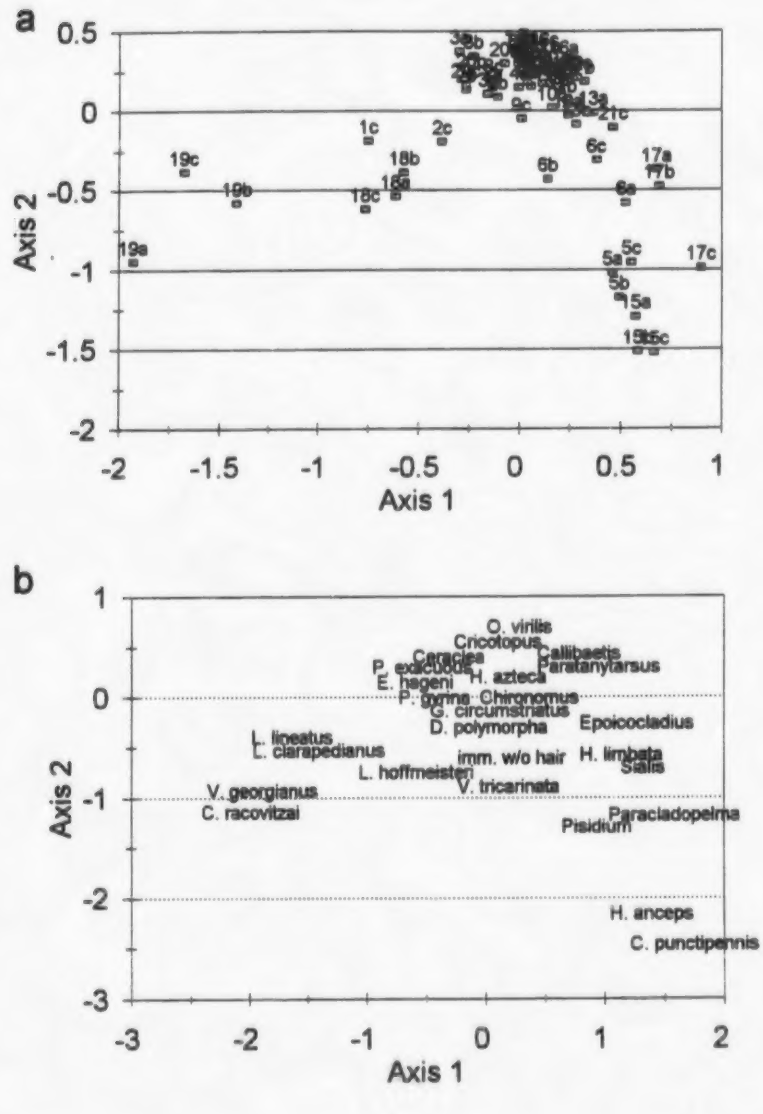

Figure J-3. Scatterplots of Correspondence Analysis (CA) axis scores. Samples close together in (a) have similar benthic communities. In (b) taxa close together tended to be found at the same sites.

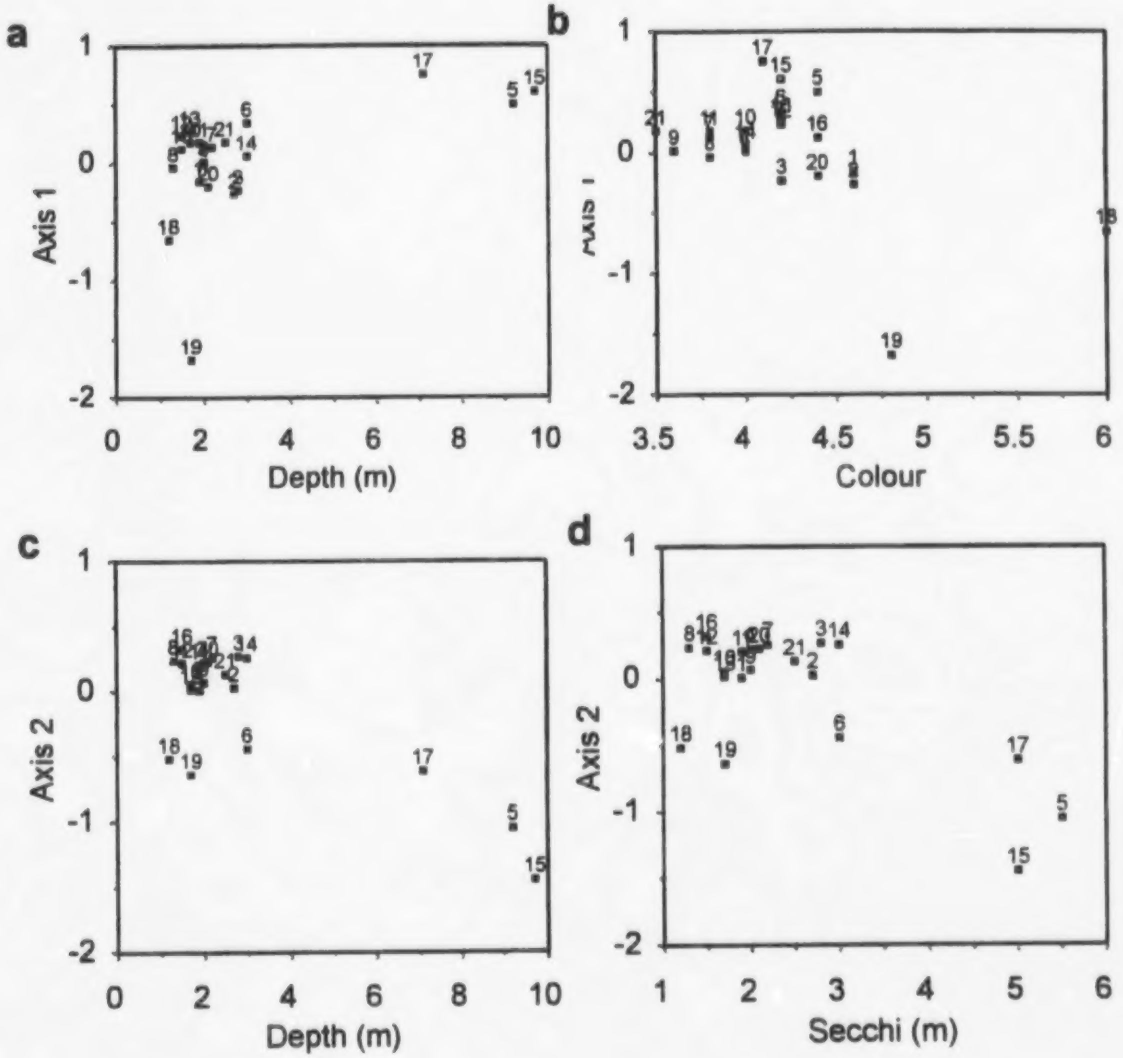

Figure J-4. Relationships between the first two ordination axes and depth, colour and secchi depth.

Appendix K

Appendix K - Benthic Collection Field Notes

Lake Couchiching

May 28/9[illegible]
STN. # 1

1) Location: Couchiching - SE of MARINA BREAKWALL (70m)
Depth: 2.0m Sampler Fullness: 5/5 Sample Bottles: 1-SNOW
Sediment Type: Silty OOZE Odour: Sulphur
Sediment Characteristics:
Macrophytes: none sparce common abundant CHARA
Algae: none sparce common abundant
Invertebrates: MIDGE, Zebra mussels, ISOPODS, HEXAGENIA, Amphipods, Dragonfly
Notes:
- Calcium build up on CHARA

2) Location: Couchiching - SE - of MARINA BREAKWALL (70 m)
Depth: 2.0m Sampler Fullness: 5/5 Sample Bottles: 1- SNOW
Sediment Type: silty OOZE Odour: Sulphur
Sediment Characteristics: - HARD CLAY, SOME ORGANICS
Macrophytes: none sparce common abundant CHARA, TUBER
Algae: none sparce common abundant
Invertebrates: MIDGE, MAYFLY, ZEBRA MUSSELS, DEAD SNAILS, CLAM
Notes:

3) Location: Couchiching - SE of MARINA BREAKWALL (70 m)
Depth: 2.0m Sampler Fullness: 5/5 Sample Bottles: 1- SNOW.
Sediment Type: SILTY OOZE, Odour: Sulphur
Sediment Characteristics: SOME HARD CLAY
Macrophytes: none sparce common abundant CHARA - TUBER
Algae: none sparce common abundant
Invertebrates: ZEBRA MUSSELS, CRAYFISH, AMPHIPOD, DAMSEL FLY, WORM
Notes: DEAD SNAILS, MIDGE, CLAM

Addition Information: 50% COVER OF CHARA & Elodea

4) COMMON CHARA, ZEBRA MUSSELS, MIDGE. 5/5. 2.0 M depth, sulphur odour

Collector: HAWK Notes By: Melissa

LAKE Couchiching

MAY 28 197
STN # 2

1) Location: Couchiching - PERPENDICULAR TO Couchiching BEACH PARK (150 m

Depth: 28 m　Sampler Fullness: 5/5　Sample Bottles: 1- SNOW

Sediment Type: Silty - ooze　Odour: Sulphur

Sediment Characteristics:

Macrophytes: none sparce common abundant CHARA

Algae: none sparce common abundant

Invertebrates: SNAILS, zebra mussels, MIDGE, DEAD SNAILS

Notes:

2) Location: Couchiching - off Couchiching BEACH PARK (150m)

Depth: 28 m　Sampler Fullness: 5/5　Sample Bottles: 1- SNOW

Sediment Type: silty - ooze　Odour: Sulphur

Sediment Characteristics:

Macrophytes: none sparce common abundant CHARA, TUBERS

Algae: none sparce common abundant

Invertebrates: zebra mussels, SNAILS, AMPHIPODS, leech, MIDGE, DEAD SNAI[illegible]

Notes:

3) Location: Couchiching - off Couchiching BEACH PARK (150 m)

Depth: 28 m　Sampler Fullness: 5/5　Sample Bottles: 1- SNOW

Sediment Type: silty - ooze　Odour: Sulphur

Sediment Characteristics:

Macrophytes: none sparce common abundant [illegible]

Algae: none sparce common abundant

Invertebrates: WORM, HEXAGENIA, ZEBRA MUSSELS, SNAILS, MIDGE, AMPHIPODS

Notes: DEAD SNAILS

Addition Information: 30 - 40% COVER CHARA P. [illegible]

4) → 5/5, sulphur smell, silty - ooze, SIMULAR TO #1

Collector: HAWKS　Notes By: Melissa

LAKE Couchiching

MAY 28/97
STn # 3

1) Location: LAKE Couchiching - 300m offshore ; 300m North of Water In
Depth: 2.7m Sampler Fullness: 4/5 Sample Bottles: 1 - SNOW
Sediment Type: Silty ooze Odour: Sulphur
Sediment Characteristics:
Macrophytes: none sparce common abundant CHARA
Algae: none sparce common abundant
Invertebrates: ZEBRA Mussels, MIDGE, AMPHIPOD, DEAD SNAILS
Notes: Heavy calcium deposits on CHARA

2) Location: Couchiching - SAME AS ABOVE
Depth: 2.7m Sampler Fullness: 4/5 Sample Bottles: 1 - SNOW
Sediment Type: Silty ooze Odour: Sulphur
Sediment Characteristics:
Macrophytes: none sparce common abundant CHARA
Algae: none sparce common abundant
Invertebrates: Amphipods, zebra mussel's MIDGE, DEAD SNAILS
Notes: Heavy calcium deposits ON CHARA

3) Location: Couchiching - SAME AS ABOVE
Depth: 2.7m Sampler Fullness: 4/5 Sample Bottles: 1 - SNOW
Sediment Type: Silty ooze Odour: Sulphur
Sediment Characteristics:
Macrophytes: none sparce common abundant [illegible]
Algae: none sparce common abundant
Invertebrates: MIDGE ZEBRA CRAYfish (THAT BITES), amphipod, CLAM, DEAD S
Notes: Heavy Calcium on Chara

Addition Information: COVER = 100% CHARA

4) 4/5, SIMILAR TO ALL ABOVE

Collector: HAWK Notes By: Melissa

LAKE Couchiching

MAY 2017

STN #4

1) Location: Couchiching - off Rafton (135m off SW pt - 525m off Wilson

Depth: 22 m Sampler Fullness: 5/5 Sample Bottles: 1 - [illegible]

Sediment Type: [illegible] Odour: N.O

Sediment Characteristics:

Macrophytes: none sparce common abundant CHARA, TUBERS

Algae: none sparce common abundant

Invertebrates: [illegible] ZEBRA MUSSELS, CADDIS FLY, DEAD SNAILS, SNA[ILS]

Notes: CALCIFIED CHARA ↳ MIDGE, DAMSELFLY, MAYFLY

2) Location: Couchiching - Ditto

Depth: 22 m Sampler Fullness: 5/5 Sample Bottles: 1 - SNCW

Sediment Type: S - OOZE Odour: Sulphur

Sediment Characteristics:

Macrophytes: none sparce common abundant CHARA TUBERS (lots)

Algae: none sparce common abundant

Invertebrates: HEXEGENIA DEAD SNAILS, midge, amphipods, SNAILS ZEBRA M[USSELS]

Notes:

3) Location: Couchiching - Ditto

Depth: 22 m Sampler Fullness: 5/5 Sample Bottles: 1 - SNCW

Sediment Type: Silt ooze Odour: Sulphur

Sediment Characteristics:

Macrophytes: none sparce common abundant CHARA TUBERS

Algae: none sparce common abundant

Invertebrates: Amphipods SNAILS CADDIS, MIDGE, HEXEGENIA, ZEBRA

Notes: [illegible] algae

Addition Information: Couch = 60% - [illegible]

4) 5/5 sulfur, silt, ooze

Collector: Hawk Notes By: Melissa

LAKE Couchiching

MAY 28/97
STN #5

1) Location: Couchiching - South of CHIEFS ISLAND (1KM)

Depth: 9.0m Sampler Fullness: 5/5 Sample Bottles: 1- SNOW

Sediment Type: Silty OOZE Odour: SLIGHT Sulphur

Sediment Characteristics:

Macrophytes: none sparce common abundant

Algae: none sparce common abundant AT SURFACE - SHORT FILAMENTS

Invertebrates: MIDGES HEXEGENIA, PHANTOM MIDGES, ZEBRA MUSSELS,

Notes:

2) Location: Couchiching - SAME AS ABOVE

Depth: 9.0m Sampler Fullness: 5/5 Sample Bottles: 1- SNOW

Sediment Type: Silty OOZE Odour: NONE

Sediment Characteristics:

Macrophytes: none sparce common abundant

Algae: none sparce common abundant

Invertebrates: MIDGE HEXEGENIA SNAIL ZEBRA MUSSELS

Notes:

3) Location: Couchiching - SAME AS ABOVE

Depth: 9.0 m Sampler Fullness: 5/5 Sample Bottles: 1- SNOW

Sediment Type: Silty OOZE Odour: NONE

Sediment Characteristics:

Macrophytes: none sparce common abundant

Algae: none sparce common abundant

Invertebrates: CLAM HEXEGENIA, MIDGE, ZEBRA MUSSELS, PHANTOM MIDGE

Notes:

Addition Information: Secchi = 6.0m

4) 5/5, Silty OOZE, NO SMELL, ALGAE

Collector: HAWK Notes By: Melissa

LAKE
Couchiching

STN # 6

1) Location: Couchiching - Between Red Bour Sch & Wilson Pt. 1/2 w.
Depth: 3.2 m
Sampler Fullness: 5/5
Sample Bottles: 1 - SNOW
Odour: NONE
Sediment Type: Silty ooze
Sediment Characteristics: - GREY
Macrophytes: none sparce common abundant TUBERS
Algae: none sparce common abundant
Invertebrates: WORMS Zebra Mussels HEXEGENIA, DEAD SNAILS (lots)
MIDGE
Notes:

2) Location: Couchiching - Same As Above
Depth: 3.2 m
Sampler Fullness:
Sample Bottles: 1 - SNOW
Odour: light Sulphur
Sediment Type: silty OOZE -
Sediment Characteristics: - GREY
Macrophytes: none sparce common abundant CHARA TUBERS
Algae: none sparce common abundant
Invertebrates: ZEBRA Mussels, MIDGE, lots of SHELLS, HEXEGENIA
Notes:

3) Location: Couchiching - Same AS Above
Depth: 3.2 m
Sampler Fullness: 5/5
Sample Bottles: 1 - SNOW
Odour: NONE
Sediment Type: Silty ooze
Sediment Characteristics: - GREY
Macrophytes: none sparce common abundant [illegible]
Algae: none sparce common abundant
Invertebrates: MIDGE, HEXEGENIA, lots of SHELLS, ZEBRA Mussels.
Notes:

Addition Information:

4) → 5/5 silty ooze - Grey slight sulphur odour. TAN SURFACE LAYER

Collector: HAWK
Notes By: [illegible]

Lake Couchiching

MAY 29/9

STN#7

1) Location: Couchiching - 300m East of shore

Depth: [illegible] Sampler Fullness: [illegible]/5 Sample Bottles: [illegible]

Sediment Type: S[illegible] OOZE Odour: STRONG Sulphur

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant [illegible]

Algae: none sparce common abundant GLOBULAR colonial [illegible]

Invertebrates: Zebra [illegible], CADDISFLY, MIDGE, SNAIL

Notes: [illegible] CALCIUM ON CHARA

2) Location: Couchiching - S[illegible] AS ABOVE

Depth: 21 m Sampler Fullness: 5/5 Sample Bottles: 1 - SN[illegible]

Sediment Type: S[illegible] OOZE Odour: [illegible] sulphur

Sediment Characteristics: [illegible] COLOUR

Macrophytes: none sparce common abundant [illegible] TUBERS

Algae: none sparce common abundant

Invertebrates: DRAGON FLY, MAYFLY, MIDGE, HEXEGENIA, ZEBRA MUSSEL[illegible]

Notes: HEAVY calcium ON CHARA

3) Location: [illegible]CHICHING - S[illegible] AS ABOVE

Depth: [illegible] M Sampler Fullness: 4/5 Sample Bottles: 1 - S[illegible]

Sediment Type: S[illegible] OOZE Odour: S[illegible] sulphur

Sediment Characteristics: GREY - colour

Macrophytes: none sparce common abundant [illegible] S[illegible]

Algae: none sparce common abundant GLOBULAR colonial ALGAE

Invertebrates: ZEBRA mussels, CRAYFISH, MIDGE

Notes: [illegible] ON CHARA

Addition Information: Cover = 95% CHARA

4) [illegible] SULPHUR ODOUR [illegible]

Collector: HAWKS Notes By: Melissa

LAKE Couchiching

MAY 27/97
STN#8

1) Location: Couchiching - 240 m off of AMIGO BEACH
Depth: 1.4m. Sampler Fullness: 5/5 Sample Bottles: 1 SNOW
Sediment Type: silty - ooze Odour: NONE
Sediment Characteristics: grey colour
Macrophytes: none sparce common abundant CHARA
Algae: none sparce common abundant
Invertebrates: crayfish snails HEXAGENIA, zebra mussels, leech MIDGE
Notes: Calcified CHARA BUT MORE NEW CHARA

2) Location: Couchiching - SAME AS ABOVE
Depth: 1.4m Sampler Fullness: 5/5 Sample Bottles: 1- SNOW
Sediment Type: silty - ooze Odour: NONE
Sediment Characteristics: grey colour
Macrophytes: none sparce common abundant CHARA
Algae: none sparce common abundant
Invertebrates: HEXAGENIA, MIDGE, ISOPODS, AMPHIPODS, ZEBRA MUSSELS
Notes: CALCIFIED CHARA

3) Location: Couchiching - SAME AS ABOVE
Depth: 1.4m Sampler Fullness: 5/5 Sample Bottles: 1- SNOW
Sediment Type: silty - ooze Odour: NONE
Sediment Characteristics: GREY IN colour.
Macrophytes: none sparce common abundant CHARA
Algae: none sparce common abundant
Invertebrates: crayfish fishfly, CLAM, LEECH, SNAILS, ZEBRA MUSSELS, MIDGE
Notes: Calcified CHARA AMPHIPOD

Addition Information: COVER = 90% CHARA THERE WAS A SULPHUR SMELL IN PRIMARY SAMPLE
1) -> 4% ... ooze, ... colour SAME AS ABOVE

Collector: HAWK Notes By: Melissa

LAKE
Couchiching

STN#C

1) Location: Couchiching - EAST of CUMBERLAND BEACH Pt.

Depth: 21m Sampler Fullness: 5/5 Sample Bottles: 1-SNOW

Sediment Type: Silty ooze Odour: NONE

Sediment Characteristics: -GREY colour

Macrophytes: none sparce common abundant CHARA

Algae: none sparce common abundant

Invertebrates: ZEBRA MUSSELS, MAYFLY, HEXEGENIA, MIDGE, AMPHIPOD, WORM

Notes: Calcified CHARA

2) Location: Couchiching - SAME AS ABOVE

Depth: 2.1 Sampler Fullness: 5/5 Sample Bottles: 1-SNOW

Sediment Type: Silty OOZE Odour: NONE

Sediment Characteristics: GREY colour

Macrophytes: none sparce common abundant CHARA

Algae: none sparce common abundant GLOBULAR COLONIAL ALGAE

Invertebrates: MIDGS CLAMS, ZEBRA MUSSELS

Notes: CALCIFIED CHARA

3) Location: Couchiching - SAME AS ABOVE

Depth: 21m Sampler Fullness: 5/5 Sample Bottles: 1-SNOW

Sediment Type: silty-OOZE Odour: Sulphur

Sediment Characteristics: GREY colour

Macrophytes: none sparce common abundant CHARA

Algae: none sparce common abundant

Invertebrates: MIDGE, ZEBRA MUSSELS, AMPHIPOD

Notes: CALCIFED CHARA

Addition Information: COVER = 90% CHARA

4) 5/5 CHARA, NO SMELL GREY Silty OOZE

Collector: HAWK Notes By: Melissa

LAKE
Couchiching

[illegible]
STN #10

1) Location: Couchiching - [illegible] offshore in centre of Cunningham Bay
Depth: [illegible] Sampler Fullness: 5/5 Sample Bottles: [illegible]
Sediment Type: silty ooze Odour: [illegible]
Sediment Characteristics: [illegible]
Macrophytes: none sparce common abundant CHARA
Algae: none sparce common abundant
Invertebrates: WORM, HEXAGENIA, MIDGE, AMPHIPOD
Notes: [illegible] CHARA, LOTS OF DEAD SNAILS

2) Location: Couchiching . Same as Above
Depth: 18 m Sampler Fullness: 4/5 Sample Bottles: 1 - SNOW
Sediment Type: silty - OOZE Odour: NONE
Sediment Characteristics: [illegible]
Macrophytes: none sparce common abundant CHARA
Algae: none sparce common abundant
Invertebrates: DRAGON FLY, HEXAGENIA, MIDGE, AMPHIPODS, WORMS, ZEBRA MUSS
Notes: [illegible] CHARA LOTS OF DEAD SNAILS

3) Location: Couchiching - Same as ABOVE
Depth: [illegible] Sampler Fullness: 4/5 Sample Bottles: 1 - SNOW
Sediment Type: Silty - OOZE Odour: NONE
Sediment Characteristics: GREY [illegible]
Macrophytes: none sparce common abundant
Algae: none sparce common abundant
Invertebrates: WORMS, HEXEGENIA, MIDGE, ZEBRA MUSSELS, CRAYFISH, AMPHIPOD
Notes: [illegible]

Addition Information: [illegible]

4) 4/5 NO [illegible] ABOVE

Collector: HAWK Notes By: MELISSA

Couchiching

MAY 30 '97

STN# 11

1) Location: Couchiching - 430m offshore (North of [illegible])

Depth: [illegible] Sampler Fullness: [illegible] Sample Bottles: [illegible]

Sediment Type: [illegible] Odour: None

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant CHARA

Algae: none sparce common abundant

Invertebrates: MIDGE, SNAILS, DRAGONFLY, HEXAGENIA, [illegible], ZEBRA MUSSELS

Notes: CALCIFIED CHARA, LOTS OF DEAD SNAILS [illegible]

2) Location: [illegible]

Depth: 20m Sampler Fullness: [illegible] Sample Bottles: 1 - [illegible]

Sediment Type: [illegible] OOZE Odour: None

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant CHARA

Algae: none sparce common abundant

Invertebrates: ZEBRA MUSSELS, HEXAGENIA, CADDISFLY, MIDGE

Notes: [illegible] CHARA, LOTS OF DEAD SNAILS

3) Location: [illegible]

Depth: 20m Sampler Fullness: 5/5 Sample Bottles: 1 - SNOW

Sediment Type: [illegible] Odour: NONE

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant

Algae: none sparce common abundant

Invertebrates: CRAYFISH, ZEBRA MUSSELS, MIDGE, HEXAGENIA, CADDISFLY

Notes: [illegible], LOTS OF DEAD SNAILS

Addition Information: [illegible]

4) [illegible]

Collector: HANK Notes By: Melissa

LAKE
Couchiching

[illegible]
STN # 12

1) Location: Couchiching - 120 [illegible] S263

Depth: [illegible] Sampler Fullness: [illegible] Sample Bottles: 1- [illegible]

Sediment Type: [illegible] Odour: [illegible]

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant [illegible]

Algae: none sparce common abundant

Invertebrates: [illegible]

Notes: [illegible]

2) Location: [illegible]

Depth: 17m Sampler Fullness: [illegible] Sample Bottles: 1- [illegible]

Sediment Type: [illegible] Odour: NONE

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant CHARA

Algae: none sparce common abundant

Invertebrates: [illegible]

Notes: [illegible]

3) Location: [illegible]

Depth: Sampler Fullness: [illegible] Sample Bottles: 1- [illegible]

Sediment Type: [illegible] Odour: SLIGHT [illegible]

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant

Algae: none sparce common abundant

Invertebrates: [illegible] HEXAGENIA, CLAMS [illegible]

Notes:

Addition Information: [illegible]

[illegible]

Collector: [illegible] Notes By: Melissa

LAKE
Couchiching

[illegible]

STN# 13

1) Location: [illegible] - 125m EAST [illegible] Floral Rd
Depth: [illegible] Sampler Fullness: [illegible] Sample Bottles: [illegible]
Sediment Type: SANDY CLAY Odour: [illegible]
Sediment Characteristics: TAN [illegible] GREY [illegible]
Macrophytes: none sparce common abundant [illegible]
Algae: none sparce common abundant
Invertebrates: [illegible] AMPHIPODS, ZEBRA [illegible]
Notes: [illegible] lot of [illegible]

2) Location: [illegible]
Depth: 1.8m Sampler Fullness: [illegible] Sample Bottles: [illegible]
Sediment Type: BROWN Silt OVER SANDY [illegible] Odour: [illegible]
Sediment Characteristics: [illegible]
Macrophytes: none sparce common abundant CHARA
Algae: none sparce common abundant
Invertebrates: [illegible]
Notes: [illegible] CHARA [illegible]

3) Location: [illegible]
Depth: 1.8m Sampler Fullness: Sample Bottles: [illegible]
Sediment Type: BROWN Silt OVER SANDY CLAY Odour: NONE
Sediment Characteristics: TAN [illegible]
Macrophytes: none sparce common abundant
Algae: none sparce common abundant
Invertebrates: ZEBRA MUSSELS, [illegible] AMPHIPOD
Notes: [illegible]

Addition Information: [illegible]

[illegible] NO ODOUR, CHARA

Collector: [illegible] Notes By: Melissa

LAKE
Couchiching

[illegible]

STN # 14

1) Location: Couchiching - 80m off of YMCA camp to the North

Depth: [illegible] Sampler Fullness: [illegible] Sample Bottles: [illegible]

Sediment Type: [illegible] Odour: NONE

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant [illegible] TUBERS

Algae: none sparce common abundant

Invertebrates: [illegible] SNAILS, DRAGONFLY, MIDGES, ZEBRA MUSSELS, MAYFLY

Notes: [illegible] DETRITUS

2) Location: Couchiching [illegible]

Depth: 3.2m Sampler Fullness: 5/5 Sample Bottles: 1 [illegible]

Sediment Type: [illegible] Odour: CHAFF

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant [illegible] TUBERS

Algae: none sparce common abundant

Invertebrates: [illegible] SNAILS [illegible]

Notes: ORGANIC DEBRIS

3) Location: [illegible]

Depth: [illegible] Sampler Fullness: 5/5 Sample Bottles: 1 [illegible]

Sediment Type: [illegible] Odour: NONE

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant [illegible]

Algae: none sparce common abundant

Invertebrates: DEAD SNAILS, MIDGES, [illegible]

Notes:

Addition Information: [illegible]

4) [illegible]

Collector: [illegible] Notes By: Melissa

LAKE
Couchiching

STN# 1

1) Location: Lake Couchiching - 1.2K NW of Geneva Park Pt.
Depth: ____ Sampler Fullness: 5/5 Sample Bottles: 1-
Sediment Type: ____ Odour: ____
Sediment Characteristics: ____
Macrophytes: none sparce common abundant
Algae: none sparce common abundant
Invertebrates: ____ MIDGES, ____ MIDGE
Notes:

2) Location: ____ SAME AS ABOVE
Depth: ____ Sampler Fullness: 5/5 Sample Bottles: 1-
Sediment Type: ____ Odour: NONE
Sediment Characteristics: ____
Macrophytes: none sparce common abundant
Algae: none sparce common abundant
Invertebrates: ____ HEXAGENIA MIDGES ____
Notes:

3) Location: ____ SAME AS ABOVE
Depth: ____ Sampler Fullness: 5/5 Sample Bottles: ____
Sediment Type: ____ Odour: NONE
Sediment Characteristics: ____
Macrophytes: none sparce common abundant
Algae: none sparce common abundant
Invertebrates: ____
Notes:

Addition Information: ____

Collector: ____ Notes By: ____

LAKE Couchiching

JUNE 07/14

STN #16

1) Location: Couchiching - 115m off of [illegible]

Depth: [illegible] Sampler Fullness: [illegible] Sample Bottles: [illegible]

Sediment Type: [illegible] Odour: [illegible]

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant CHARA [illegible]

Algae: none sparce common abundant

Invertebrates: [illegible] MUSSEL AMPHIPOD

Notes:

2) Location: [illegible] - SAME AS ABOVE

Depth: [illegible] Sampler Fullness: [illegible] Sample Bottles: 1-[illegible]

Sediment Type: [illegible] Odour: [illegible]

Sediment Characteristics:

Macrophytes: none sparce common abundant [illegible]

Algae: none sparce common abundant

Invertebrates: [illegible] ZEBRA MUSSELS [illegible]

Notes:

3) Location: [illegible] - SAME AS ABOVE

Depth: 1 [illegible] Sampler Fullness: 5/5 Sample Bottles: [illegible]

Sediment Type: [illegible] Odour: [illegible]

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant [illegible]

Algae: none sparce common abundant

Invertebrates: ZEBRA MUSSELS MIDGE MAYFLY, AMPHIPOD, DAMSELFLY, DRAGONFLY

Notes: [illegible]

Addition Information: [illegible]

5/5 [illegible]

Collector: [illegible] Notes By: Melissa

LAKE Couchiching

STN # 17

1) Location: Couchiching - 435 PERPENDICULAR TO CASINO RAMA WATER T[illegible]

Depth: [illegible] Sampler Fullness: [illegible] Sample Bottles: [illegible]

Sediment Type: Silt [illegible] Odour: [illegible]

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant

Algae: none sparce common abundant

Invertebrates: HEXAGENIA, DEAD SNAILS, [illegible] ZEBRA [illegible]

Notes: + PHANTOM MIDGE

2) Location: Couchiching [illegible]

Depth: 68m Sampler Fullness: [illegible] Sample Bottles: 1- [illegible]

Sediment Type: S[illegible]

Odour:

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant

Algae: none sparce common abundant

Invertebrates: FISHFLY DEAD SNAIL [illegible] MUSSEL [illegible] HEXAGENIA [illegible]

Notes: + PHANTOM MIDGE, [illegible]

3) Location: COUCHICHING - [illegible]

Depth: [illegible] Sampler Fullness: [illegible] Sample Bottles: [illegible]

Sediment Type: [illegible]

Odour: NONE.

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant

Algae: none sparce common abundant

Invertebrates: [illegible] ZEBRA MUSSELS, [illegible]

Notes: [illegible]

Addition Information:

- [illegible] TO SEE [illegible]

4) [illegible]

Collector: [illegible]

Notes By: [illegible]

Couchiching

STn #18

1) Location: Couchiching - 110m off of mouth of Sucker Creek

Depth: 1.1m Sampler Fullness: 3/5 Sample Bottles: 1- [illegible]

Sediment Type: Silty - SAND Odour: [illegible]

Sediment Characteristics: ORGANIC DEBRIS HARD KLAY IN [illegible]

Macrophytes: none sparce common abundant CHARA DUCKWEED-(LITTLE BIT) ELODE[illegible]

Algae: none sparce common abundant

Invertebrates: MIDGE, CLAM, WORMS, AMPHIPOD

Notes: lots of MIDGE

2) Location: COUCHICHING - SAME AS ABOVE

Depth: 1.4m Sampler Fullness: 4/5 Sample Bottles: 1-SNOW

Sediment Type: Silty - SAND Odour: [illegible]

Sediment Characteristics: SOME HARD CLAY

Macrophytes: none sparce common abundant CHARA DUCKWEED (SPARSE)

Algae: none sparce common abundant

Invertebrates: MIDGE, WORMS

Notes: lots of MIDGE

3) Location: [illegible] - SAME AS ABOVE

Depth: 1.4 Sampler Fullness: 4/5 Sample Bottles: 1-SNOW

Sediment Type: SILTY - SAND Odour: sulphur (Slight)

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant

Algae: none sparce common abundant

Invertebrates: [illegible], MAYFLY, SNAIL

Notes: [illegible]

Addition Information: [illegible]

[illegible] SLIGHT SULF[illegible]

Collector: HANK Notes By: Melissa

LAKE Couchiching

STN #49

1) Location: Couchiching - 400 m South of NADIE ISLAND

Depth: 1.8 m Sampler Fullness: 5/5 Sample Bottles: [illegible]

Sediment Type: [illegible] Odour: [illegible]

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant CHARA ELODEA ([illegible])

Algae: none sparce common abundant

Invertebrates: SNAILS, ZEBRA MUSSELS, ISOPODS, MIDGE, AMPHIPOD

Notes:

2) Location: Couchiching - SAME AS ABOVE

Depth: 1.8 m Sampler Fullness: 5/5 Sample Bottles: 1 - SNOW

Sediment Type: [illegible] Odour: [illegible]

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant [illegible]

Algae: none sparce common abundant

Invertebrates: SNAILS, MIDGES, ISOPODS, AMPHIPODS, ZEBRA MUSSELS

Notes:

3) Location: Couchiching - SAME AS ABOVE

Depth: 1.9 m Sampler Fullness: 4/5 Sample Bottles: 1 - [illegible]

Sediment Type: [illegible] Odour: [illegible]

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant [illegible]

Algae: none sparce common abundant

Invertebrates: Amphipods, lots of SNAILS, ZEBRA MUSSELS

Notes:

Addition Information: [illegible]

[illegible]

Collector: HAWK Notes By: Melissa

LAKE
Conchichinor

[illegible]
STN #20

1) Location: Conchichina - [illegible] off of MOOSE BEACH

Depth: [illegible] m   Sampler Fullness: [illegible]   Sample Bottles: [illegible]

Sediment Type: [illegible]   Odour: NONE

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant   CHARA

Algae: none sparce common abundant

Invertebrates: ZEBRA MUSSELS [illegible] MIDGE [illegible]

Notes: [illegible]

2) Location: Conchichina - SAME AS ABOVE

Depth: [illegible] m   Sampler Fullness: 5/5   Sample Bottles: 1-SNOW

Sediment Type: [illegible]   Odour: Sulphur

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant   CHARA

Algae: none sparce common abundant

Invertebrates: [illegible] MUSSELS [illegible] MIDGE, WORM

Notes:

3) Location: [illegible]

Depth: Sampler Fullness: 5/5   Sample Bottles: [illegible]

Sediment Type: [illegible]   Odour: [illegible]

Sediment Characteristics: Grey [illegible]

Macrophytes: none sparce common abundant

Algae: none sparce common abundant

Invertebrates: [illegible] MIDGE CRAYFISH - CADDISFLY

Notes:

Addition Information: [illegible]

[illegible] FISH

Collector: HAWK   Notes By: Melissa

LAKE
Couchiching

June 2/97
STN# 21

1) Location: Couchiching [illegible] CLIFFE IS[illegible]

Depth: [illegible] Sampler Fullness: [illegible] Sample Bottles: [illegible]

Sediment Type: [illegible] Odour: [illegible]

Sediment Characteristics:

Macrophytes: none sparce common abundant CHARA [illegible]

Algae: none sparce common abundant

Invertebrates: CRAYFISH, [illegible]

Notes:

2) Location: [illegible] SAME [illegible]

Depth: [illegible] Sampler Fullness: [illegible] Sample Bottles: 1-[illegible]

Sediment Type: [illegible] Odour: S[illegible]

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abundant CHARA

Algae: none sparce common abundant

Invertebrates: LOT OF DEAD [illegible] MUSSELS [illegible]

Notes:

3) Location: [illegible]

Depth: [illegible] Sampler Fullness: [illegible] Sample Bottles: [illegible]

Sediment Type: [illegible] Odour: [illegible]

Sediment Characteristics: [illegible]

Macrophytes: none sparce common abuncant [illegible]

Algae: none sparce common abundant

Invertebrates: [illegible], DEAD [illegible] ([illegible]) [illegible], ZEBRA MUSSELS

Notes:

Addition Information: [illegible]

4) [illegible] CHARA

Collector: [illegible] Notes By: [illegible]

Appendix L

Appendix L - Raw Benthic Macroinvertebrate Data

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	1	1	1	2	2	2	3	3	3	4	4	4
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28
Original % Subsampled	25	50	25	50	25	25	25	25	25	25	25	25
<u>TAXA LIST</u>												
ANNELIDA:HIRUDINEA												
ERPOBDELLIDAE:(juveniles)												
Mooreobdella fervida												
Nephelopsis obscura					4							
GLOSSIPHONIIDAE:												
Alboglossiphonia heteroclita												
Desserobdella phalera							4					
Glossiphonia complanata												
Helobdella elongata		2										
Helobdella fusca												
Helobdella triserialis												4
ANNELIDA:OLIGOCHAETA												
ENCHYTRAEIDAE:												
NAIDIDAE:												
Nais communis												
Ophidonais serpentina												
SPARGANOPHILIDAE:												
Sparganophilus eiseni			4									
TUBIFICIDAE:												
Immatures with hairs	4					4	4		4	12	16	28
Immatures without hairs												
Aulodrilus pigueti												
Aulodrilus pluriseta												
Ilyodrilus templetoni												
Limnodrilus clarapedianus												
Limnodrilus hoffmeisteri												
Potamothrix bavaricus	4					24		4		8	8	32
ANNELIDA:POLYCHAETA												
Manayunkia speciosa												
ACARINA:												

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	1	1	1	2	2	2	3	3	3	4	4	4
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28
Original % Subsampled	25	50	25	50	25	25	25	25	25	25	25	25
Albia												
Arrenurus										4		
Hygrobates		4	8						4	12	8	28
Konikea												
Lebertia								4	4			
Limnesia								4				
Unionicola												
CRUSTACEA												
AMPHIPODA:												
GAMMARIDAE:												
Gammarus fasciatus												
Gammarus pseudolimnaeus	8		24		4	4			4	16		12
HYALELLIDAE:												
Hyalella azteca	280	34	748	92	288	40	612	324	392	300	132	256
CLADOCERA:												
CHYDORIDAE:												
Eurycercus				2	8					12	20	32
DECAPODA:												
CAMBARIDAE:												
Orconectes virilis									4			
ISOPODA:												
ASELLIDAE:												
Caecidotea intermedius	16				12	8						
Caecidotea racovitzai			76									
Lirceus lineatus			48									
INSECTA:												
COLEOPTERA:												
ELMIDAE:												
Stenelmis												
DIPTERA:												
CERATOPOGONIDAE:				2		4					4	28
CHAOBORIDAE:												

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	1	1	1	2	2	2	3	3	3	4	4	4
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28
Original % Subsampled	25	50	25	50	25	25	25	25	25	25	25	25
Chaoborus punctipennis									4			
CHIRONOMIDAE:												
CHIRONOMINAE:												
Chironomus	24	8	4				76	32	60			
Cladotanytarsus		2								56		56
Cryptochironomus		8										
Dicrotendipes	12	6	80	6	56	4	64	52	76	72	8	28
Microtendipes										4		
Parachironomus	4			2								
Paracladopelma				2								
Paratanytarsus										16	28	16
Paratendipes	8	4	32		196	16			12	40	40	140
Phaenopsectra flavipes					4							
Polypedilum				14		4				36	8	64
Pseudochironomus										8		
Stempellina		2								4	12	
Tanytarsus	44	62	48	22	52	4			8	20	8	16
Tribelos jucundum	16			18		8				8	20	16
Zavreleilla												
ORTHOCLADIINAE:												
Cricotopus	4		8	16	8		20	8	20			4
Epoicocladius												
Psectrocladius	4	4		6	36		12	16	8	4		8
Thienemanniella												
TANYPODINAE:												
Ablabesmyia	8		8	12	72		48	48	44	40	32	68
Clinotanypus pinguis				4							4	
Procladius	8	24	32	14	28					80	20	72
EMPIDIDAE:												
Hemerodromia												
EPHEMEROPTERA:												
BAETIDAE:												

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	1	1	1	2	2	2	3	3	3	4	4	4
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.05.28	97.05.28	97.05.28	97.05.28	97.05 28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28
Original % Subsampled	25	50	25	50	25	25	25	25	25	25	25	25
Callibaetis			4	2				4		4	4	8
CAENIDAE:												
Caenis punctata	92	38	172	2			24	24	12	4	4	4
EPHEMERELLIDAE:												
Eurylophella										4	12	
EPHEMERIDAE:												
Hexagenia limbata		2				4						4
LEPTOPHLEBIIDAE:												
Leptophlebia												
MEGALOPTERA:												
SIALIDAE:												
Sialis												
ODONATA:												
COENAGRIONIDAE:												
Enallagma sp.		2							4			
Enallagma civile			4						4			
Enallagma hageni			20									
CORDULIIDAE:												
Tetragoneuria cynosura												
TRICHOPTERA:												
HYDROPTILIDAE:												
Orthotrichia			4									
LEPTOCERIDAE:												
Ceraclea						4	16	8	4			4
Mystacides sepulchralis	4									4		
Nectopsyche albida								4		8	12	16
Oecetis inconspicua-group	4	6		4				4		8	16	20
Triaenodes	4		4					4				
POLYCENTROPODIDAE												
Polycentropus								4				
MOLLUSCA:BIVALVIA:												
DREISSENIDAE:												

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	1	1	1	2	2	2	3	3	3	4	4	4
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28
Original % Subsampled	25	50	25	50	25	25	25	25	25	25	25	25
Dreissena polymorpha	28	6	312	144	1016	280	276	412	500	200	208	448
SPHAERIIDAE:												
Pisidium			4									
Sphaerium simile												
Sphaerium striatinum		2	4									
UNIONIDAE:												
Lampsilis radiata												
MOLLUSCA:GASTROPODA:												
ANCYLIDAE:												
Ferrissia												
HYDROBIIDAE												
Amnicola limosa	4	2	12	46	164	52	44	16	16	44	168	136
Cincinnatia cincinnatiensis												
Probythinia lacustris												
PHYSIDAE:												
Physella gyrina			8		4					12	8	12
PLANORBIDAE:												
Gyraulus circumstriatus				2	8	4	8	4	4	4	20	
Helisoma anceps												
Promenetus exacuous			4			8	8	12	12			
VALVATIDAE:												
Valvata tricarinata						4		12	8	36	56	16
VIVIPARIDAE:												
Viviparus georgianus				16	8	8						
NEMATODA:	12	2	8			12				4		4
PLATYHELMINTHES:												
Dugesia tigrina			4				8					
Hydrolimax griseus												
Total Number of Taxa	22	20	27	21	18	20	15	21	23	32	26	30
Total Number of Specimens	592	220	1684	428	1968	496	1224	1000	1208	1084	876	1580

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	5	5	5	6	6	6	7	7	7	8	8	8
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29
Original % Subsampled	50	25	25	50	50	50	25	25	25	25	25	25
TAXA LIST												
ANNELIDA:HIRUDINEA												
ERPOBDELLIDAE:(juveniles)												
Mooreobdella fervida							4					4
Nephelopsis obscura												
GLOSSIPHONIIDAE:												
Alboglossiphonia heteroclita												
Desserobdella phalera									4			
Glossiphonia complanata												
Helobdella elongata						2						
Helobdella fusca												
Helobdella triserialis												
ANNELIDA:OLIGOCHAETA												
ENCHYTRAEIDAE:												
NAIDIDAE:												
Nais communis												
Ophidonais serpentina												
SPARGANOPHILIDAE:												
Sparganophilus eiseni				6		14						
TUBIFICIDAE:												
Immatures with hairs		4					4					
Immatures without hairs				4				4				
Aulodrilus pigueti	8	12										
Aulodrilus pluriseta												
Ilyodrilus templetoni												
Limnodrilus claparedianus												
Limnodrilus hoffmeisteri					2						4	4
Potamothrix bavaricus												
ANNELIDA:POLYCHAETA												
Manayunkia speciosa												
ACARINA:												

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	5	5	5	6	6	6	7	7	7	8	8	8
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29
Original % Subsampled	50	25	25	50	50	50	25	25	25	25	25	25
Albia												
Arrenurus							4		4	4		
Hygrobates							8		4		4	12
Konikea												
Lebertia										4		
Limnesia	2										4	
Unionicola						2	4					
CRUSTACEA												
AMPHIPODA:												
GAMMARIDAE:												
Gammarus fasciatus												
Gammarus pseudolimnaeus										4	8	
HYALELLIDAE:												
Hyalella azteca					4		252	88	232	240	464	816
CLADOCERA:												
CHYDORIDAE:												
Eurycercus										4		
DECAPODA:												
CAMBARIDAE:												
Orconectes virilis										4		4
ISOPODA:												
ASELLIDAE:												
Caecidotea intermedius												
Caecidotea racovitzai												
Lirceus lineatus										4	4	8
INSECTA:												
COLEOPTERA:												
ELMIDAE:												
Stenelmis	2											
DIPTERA:												
CERATOPOGONIDAE:	6		4				8			4		4
CHAOBORIDAE:												

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	5	5	5	6	6	6	7	7	7	8	8	8
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29
Original % Subsampled	50	25	25	50	50	50	25	25	25	25	25	25
Chaoborus punctipennis	14	12	12									
CHIRONOMIDAE:												
CHIRONOMINAE:												
Chironomus	6		44									
Cladotanytarsus			16									
Cryptochironomus											4	12
Dicrotendipes	4	12			2		96	20	96	104	144	148
Microtendipes												
Parachironomus												
Paracladopelma				2								
Paratanytarsus							4					
Paratendipes	10			12	2	14	28	44	28	44	32	112
Phaenopsectra flavipes												
Polypedilum	2	4		14		2	4	4	4	8	12	8
Pseudochironomus												4
Stempellina								4	4	16		
Tanytarsus	42	40	48	2		2	8	24	24	12	36	40
Tribelos jucundum	2		4					8		8	40	24
Zavreleilla												
ORTHOCLADIINAE:												
Cricotopus							4		4		8	8
Epoicocladius				2							4	
Psectrocladius		4	4		4		4	4	8	12	20	40
Thienemanniella												
TANYPODINAE:												
Ablabesmyia				2		6	20	24	36	16	20	32
Clinotanypus pinguis									4	8	8	
Procladius	16	12	12	10	6	14	8	28	32	12	36	32
EMPIDIDAE:												
Hemerodromia									4			4
EPHEMEROPTERA:												
BAETIDAE:												

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	5	5	5	6	6	6	7	7	7	8	8	8
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29
Original % Subsampled	50	25	25	50	50	50	25	25	25	25	25	25
Callibaetis										4		
CAENIDAE:												
Caenis punctata	2			4		10	28	104	88	44	44	200
EPHEMERELLIDAE:												
Eurylophella								8			4	12
EPHEMERIDAE:												
Hexagenia limbata	2	8	24	24	20	24		28	4	4	4	
LEPTOPHLEBIIDAE:												
Leptophlebia												
MEGALOPTERA:												
SIALIDAE:												
Sialis												
ODONATA:												
COENAGRIONIDAE:												
Enallagma sp.												
Enallagma civile												
Enallagma hageni										4		
CORDULIIDAE:												
Tetragoneuria cynosura								4				
TRICHOPTERA:												
HYDROPTILIDAE:												
Orthotrichia												
LEPTOCERIDAE:												
Ceraclea												8
Mystacides sepulchralis					2							
Nectopsyche albida						2	4		4	4	4	4
Oecetis inconspicua-group							4		4	4	8	
Triaenodes												
POLYCENTROPODIDAE												
Polycentropus						2	4				12	16
MOLLUSCA:BIVALVIA:												
DREISSENIDAE:												

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	5	5	5	6	6	6	7	7	7	8	8	8
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.28	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29
Original % Subsampled	50	25	25	50	50	50	25	25	25	25	25	25
Dreissena polymorpha	660	1724	120	36	122	82	180	88	208	284	132	344
SPHAERIIDAE:												
Pisidium	42	48	12	2	2	4					4	12
Sphaerium simile												4
Sphaerium striatinum			4									
UNIONIDAE:		4										
Lampsilis radiata												
MOLLUSCA:GASTROPODA:												
ANCYLIDAE:												
Ferrissia								8				
HYDROBIIDAE												
Amnicola limosa	4	8	36	4	10	4	32		32	40	40	76
Cincinnatia cincinnatiensis	4	8										
Probythinia lacustris			4									
PHYSIDAE:												
Physella gyrina					2					8	4	20
PLANORBIDAE:												
Gyraulus circumstriatus	6	8					12		36			
Helisoma anceps	2	4										
Promenetus exacuous												
VALVATIDAE:												
Valvata tricarinata	64	108	32						12			
VIVIPARIDAE:												
Viviparus georgianus												
NEMATODA:												
PLATYHELMINTHES:												
Dugesia tigrina						2			4			4
Hydrolimax griseus												
Total Number of Taxa	21	17	15	14	12	16	23	17	24	27	28	30
Total Number of Specimens	900	2020	376	124	178	186	724	492	880	904	1108	2016

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	9	9	9	10	10	10	11	11	11	12	12	12
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.05.29	97.05.29	97.05.29	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30
Original % Subsampled	25	25	50	25	25	25	25	25	25	25	25	25
TAXA LIST												
ANNELIDA:HIRUDINEA												
ERPOBDELLIDAE:(juveniles)												
Mooreobdella fervida												
Nephelopsis obscura							4					
GLOSSIPHONIIDAE:												
Alboglossiphonia heteroclita												
Desserobdella phalera									4			
Glossiphonia complanata	4											
Helobdella elongata												
Helobdella fusca												
Helobdella triserialis												
ANNELIDA:OLIGOCHAETA												
ENCHYTRAEIDAE:												
NAIDIDAE:												
Nais communis												
Ophidonais serpentina												
SPARGANOPHILIDAE:												
Sparganophilus eiseni				8	8	8						
TUBIFICIDAE:												
Immatures with hairs												
Immatures without hairs		4					12		4			
Aulodrilus pigueti												
Aulodrilus pluriseta												
Ilyodrilus templetoni						8						
Limnodrilus claparedianus		4						4				
Limnodrilus hoffmeisteri							4		4			
Potamothrix bavaricus												
ANNELIDA:POLYCHAETA												
Manayunkia speciosa												
ACARINA:												

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	9	9	9	10	10	10	11	11	11	12	12	12
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.05.29	97.05.29	97.05.29	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30
Original % Subsampled	25	25	50	25	25	25	25	25	25	25	25	25
Albia												
Arrenurus									16			
Hygrobates	16	8			4			4				
Konikea	4	4			8			8				
Lebertia	4	4							4			
Limnesia	4							4				
Unionicola												
CRUSTACEA												
AMPHIPODA:												
GAMMARIDAE:												
Gammarus fasciatus												
Gammarus pseudolimnaeus	4											
HYALELLIDAE:												
Hyalella azteca	480	276	66	184	292	316	140	224	208	260	276	132
CLADOCERA:												
CHYDORIDAE:												
Eurycercus												
DECAPODA:												
CAMBARIDAE:												
Orconectes virilis										4		
ISOPODA:												
ASELLIDAE:												
Caecidotea intermedius												
Caecidotea racovitzai												
Lirceus lineatus												
INSECTA:												
COLEOPTERA:												
ELMIDAE:												
Stenelmis												
DIPTERA:												
CERATOPOGONIDAE:	4	32	2	4	16	8	12	4	4	8	12	4
CHAOBORIDAE:												

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	9	9	9	10	10	10	11	11	11	12	12	12
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.05.29	97.05.29	97.05.29	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30
Original % Subsampled	25	25	50	25	25	25	25	25	25	25	25	25
Chaoborus punctipennis			2									
CHIRONOMIDAE:												
CHIRONOMINAE:												
Chironomus												
Cladotanytarsus		4		4		4				4	8	4
Cryptochironomus		4			8		4		8			
Dicrotendipes	132	80	62	36	116	36	148	136	100	96	92	52
Microtendipes												
Parachironomus												
Paracladopelma												
Paratanytarsus	16			28	20	4	4			8	8	
Paratendipes	60	64	30				20	8	8	8	8	32
Phaenopsectra flavipes												
Polypedilum	12					4	38	20	24		8	4
Pseudochironomus	16	8	4	24	12	24	16		4	8		8
Stempellina					4		4		4			
Tanytarsus	4		4	4	8	12	8	4	4	56	28	4
Tribelos jucundum	12	12		16	16		32	12	20	40	64	68
Zavreleilla									8			
ORTHOCLADIINAE:												
Cricotopus			2		4					8		
Epoicocladius					4							
Psectrocladius	12	8	4		8	4		12		68	32	32
Thienemanniella							4					
TANYPODINAE:												
Ablabesmyia	24	36	6	4	20	4	8	28	40	72	60	20
Clinotanypus pinguis	4	4			4	4	8	4		20	4	4
Procladius	40	8	2	8	8	4	36	20	20	20	28	16
EMPIDIDAE:												
Hemerodromia												
EPHEMEROPTERA:												
BAETIDAE:												

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	9	9	9	10	10	10	11	11	11	12	12	12
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.05.29	97.05.29	97.05.29	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30
Original % Subsampled	25	25	50	25	25	25	25	25	25	25	25	25
Callibaetis	4	12				4		8	8	4		
CAENIDAE:												
Caenis punctata	44	112	18		20	4	108	76	164	12	40	8
EPHEMERELLIDAE:												
Eurylophella							4					
EPHEMERIDAE:												
Hexagenia limbata	4			4	4	8	24	8	36	20	8	16
LEPTOPHLEBIIDAE:												
Leptophlebia												
MEGALOPTERA:												
SIALIDAE:												
Sialis												
ODONATA:												
COENAGRIONIDAE:												
Enallagma sp.	4											
Enallagma civile												
Enallagma hageni												
CORDULIIDAE:												
Tetragoneuria cynosura	4						4	4				
TRICHOPTERA:												
HYDROPTILIDAE:												
Orthotrichia												
LEPTOCERIDAE:												
Ceraclea												
Mystacides sepulchralis					4	4						
Nectopsyche albida	4				12							
Oecetis inconspicua-group	4		2	16	20	8						
Triaenodes												
POLYCENTROPODIDAE												
Polycentropus	4						8		8	20	12	4
MOLLUSCA:BIVALVIA:												
DREISSENIDAE:												

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	9	9	9	10	10	10	11	11	11	12	12	12
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.05.29	97.05.29	97.05.29	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30	97.05.30
Original % Subsampled	25	25	50	25	25	25	25	25	25	25	25	25
Dreissena polymorpha	600	392	130	360	1120	1224	216	136	224	436	276	96
SPHAERIIDAE:												
Pisidium	4			8	8	4				4		
Sphaerium simile		4										
Sphaerium striatinum		4										
UNIONIDAE:												
Lampsilis radiata												
MOLLUSCA:GASTROPODA:												
ANCYLIDAE:												
Ferrissia												
HYDROBIIDAE												
Amnicola limosa	8	68	26	8	16	4	20	48	20	44	28	20
Cincinnatia cincinnatiensis												
Probythinia lacustris												
PHYSIDAE:												
Physella gyrina	4	8	2		4					8	4	
PLANORBIDAE:												
Gyraulus circumstriatus	4				4	8						
Helisoma anceps	4											
Promenetus exacuous												
VALVATIDAE:												
Valvata tricarinata	4	40	8						4		4	
VIVIPARIDAE:												
Viviparus georgianus												
NEMATODA:												
PLATYHELMINTHES:												
Dugesia tigrina					4					4		
Hydrolimax griseus												
Total Number of Taxa	34	25	17	16	29	23	25	21	25	24	20	18
Total Number of Specimens	1552	1200	370	716	1776	1708	884	772	948	1232	1000	524

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	13	13	13	14	14	14	15	15	15	16	16	16
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.05.30	97.05.30	97.05.30	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02
Original % Subsampled	25	25	25	25	25	25	50	50	50	25	25	25
TAXA LIST												
ANNELIDA:HIRUDINEA												
ERPOBDELLIDAE:(juveniles)												
Mooreobdella fervida												
Nephelopsis obscura										4		4
GLOSSIPHONIIDAE:												
Alboglossiphonia heteroclita												
Desserobdella phalera												
Glossiphonia complanata												
Helobdella elongata												
Helobdella fusca										4		
Helobdella triserialis												
ANNELIDA:OLIGOCHAETA												
ENCHYTRAEIDAE:												
NAIDIDAE:												
Nais communis												
Ophidonais serpentina												
SPARGANOPHILIDAE:												
Sparganophilus eiseni	4				4				2			
TUBIFICIDAE:												
Immatures with hairs				64	40	176		2				
Immatures without hairs				4		12	8	2				
Aulodrilus pigueti												
Aulodrilus pluriseta							12	4	14			
Ilyodrilus templetoni												
Limnodrilus clarapedianus												
Limnodrilus hoffmeisteri								2				
Potamothrix bavaricus				12	12	36						
ANNELIDA:POLYCHAETA												
Manayunkia speciosa							2	2				
ACARINA:												

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	13	13	13	14	14	14	15	15	15	16	16	16
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.05.30	97.05.30	97.05.30	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02
Original % Subsampled	25	25	25	25	25	25	50	50	50	25	25	25
Albia												
Arrenurus				4	4					12		
Hygrobates			4	4						4		
Konikea												
Lebertia		4								8		4
Limnesia												
Unionicola												
CRUSTACEA												
AMPHIPODA:												
GAMMARIDAE:												
Gammarus fasciatus												
Gammarus pseudolimnaeus		4				4			2			12
HYALELLIDAE:												
Hyalella azteca	244	120	188	204	144	124				232	176	264
CLADOCERA:												
CHYDORIDAE:												
Eurycercus												
DECAPODA:												
CAMBARIDAE:												
Orconectes virilis												
ISOPODA:												
ASELLIDAE:												
Caecidotea intermedius												
Caecidotea racovitzai												
Lirceus lineatus												
INSECTA:												
COLEOPTERA:												
ELMIDAE:												
Stenelmis												
DIPTERA:												
CERATOPOGONIDAE:	28	4		16	12	12				12	4	8
CHAOBORIDAE:												

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	13	13	13	14	14	14	15	15	15	16	16	16
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.05.30	97.05.30	97.05.30	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02
Original % Subsampled	25	25	25	25	25	25	50	50	50	25	25	25
Chaoborus punctipennis							12	30	42			
CHIRONOMIDAE:												
CHIRONOMINAE:												
Chironomus	4			92	40	108	2	2				
Cladotanytarsus	20	8	8				14	12	2	60	32	36
Cryptochironomus	4	4	4					2	4			
Dicrotendipes	16	12	12	188	164	192				184	80	164
Microtendipes		12	8									
Parachironomus			4									
Paracladopelma		4						2				
Paratanytarsus	12			24		8						4
Paratendipes	8	8	8	28	80	184	4		2	244	16	20
Phaenopsectra flavipes										8		
Polypedilum	4	4			12	12			4	32	20	40
Pseudochironomus											4	
Stempellina											4	4
Tanytarsus	32	12	12	8	44	48	10	2	14	204	64	92
Tribelos jucundum	48	32	36	44	52	40		2				16
Zavreleilla												
ORTHOCLADIINAE:												
Cricotopus										24	8	8
Epoicocladius	4											
Psectrocladius	16	4		8						4		
Thienemanniella												
TANYPODINAE:												
Ablabesmyia	24	12	20	36	20	16	2	2		12		
Clinotanypus pinguis	12	4	4							16	8	16
Procladius	12	4			8	4	2	2	2	60	12	48
EMPIDIDAE:												
Hemerodromia												
EPHEMEROPTERA:												
BAETIDAE:												

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	13	13	13	14	14	14	15	15	15	16	16	16
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.05.30	97.05.30	97.05.30	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02
Original % Subsampled	25	25	25	25	25	25	50	50	50	25	25	25
Callibaetis										4		
CAENIDAE:												
Caenis punctata	24	8	28	24	4	20				120	52	100
EPHEMERELLIDAE:												
Eurylophella												
EPHEMERIDAE:												
Hexagenia limbata	32	56	28				22	6	10			
LEPTOPHLEBIIDAE:												
Leptophlebia				4								
MEGALOPTERA:												
SIALIDAE:												
Sialis						4						
ODONATA:												
COENAGRIONIDAE:												
Enallagma sp.										4		
Enallagma civile												
Enallagma hageni				4	4						8	12
CORDULIIDAE:												
Tetragoneuria cynosura				4		4					4	
TRICHOPTERA:												
HYDROPTILIDAE:												
Orthotrichia												
LEPTOCERIDAE:												
Ceraclea											4	
Mystacides sepulchralis												
Nectopsyche albida			4	4						12	4	4
Oecetis inconspicua-group		4	4	16	4	12						
Triaenodes												
POLYCENTROPODIDAE												
Polycentropus	4		4	8	4	8						8
MOLLUSCA:BIVALVIA:												
DREISSENIDAE:												

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	13	13	13	14	14	14	15	15	15	16	16	16
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.05.30	97.05.30	97.05.30	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02	97.06.02
Original % Subsampled	25	25	25	25	25	25	50	50	50	25	25	25
Dreissena polymorpha	532	272	316	816	1320	1868	26	328	132	140	128	148
SPHAERIIDAE:												
Pisidium	4						22	30	4	4		
Sphaerium simile												
Sphaerium striatinum												
UNIONIDAE:												
Lampsilis radiata	4							2	2			
MOLLUSCA:GASTROPODA:												
ANCYLIDAE:												
Ferrissia												
HYDROBIIDAE												
Amnicola limosa	52	20	12	24	28	52	76	28	32	52	28	28
Cincinnatia cincinnatiensis												
Probythinia lacustris								14	20			
PHYSIDAE:												
Physella gyrina				4								
PLANORBIDAE:												
Gyraulus circumstriatus												
Helisoma anceps								2	2			
Promenetus exacuous												
VALVATIDAE:												
Valvata tricarinata		4				4	10	16	10			
VIVIPARIDAE:												
Viviparus georgianus												
NEMATODA:	4							8	10			
PLATYHELMINTHES:												
Dugesia tigrina	4	4	4	4	4	16		2				
Hydrolimax griseus						16						
Total Number of Taxa	26	24	20	26	21	24	15	24	19	25	19	22
Total Number of Specimens	1152	620	708	1648	2004	2964	224	504	310	1460	656	1040

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	17	17	17	18	18	18	19	19	19	20	20	20
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.06.02	97.06.02	97.06.02	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29
Original % Subsampled	100	50	100	25	25	25	25	25	25	25	25	25
<u>TAXA LIST</u>												
ANNELIDA:HIRUDINEA												
ERPOBDELLIDAE:(juveniles)							4					
Mooreobdella fervida									4			
Nephelopsis obscura												
GLOSSIPHONIIDAE:												
Alboglossiphonia heteroclita							4		4			
Desserobdella phalera										4		
Glossiphonia complanata												
Helobdella elongata												
Helobdella fusca												
Helobdella triserialis												
ANNELIDA:OLIGOCHAETA												
ENCHYTRAEIDAE:				4								
NAIDIDAE:												
Nais communis				24	8				8			
Ophidonais serpentina						4						
SPARGANOPHILIDAE:												
Sparganophilus eiseni				4	4	4		4			4	
TUBIFICIDAE:												
Immatures with hairs						4					8	
Immatures without hairs				24	8		8					
Aulodrilus pigueti												
Aulodrilus pluriseta												
Ilyodrilus templetoni												
Limnodrilus claparedianus							4		4			
Limnodrilus hoffmeisteri				4	8	8	8		4		4	
Potamothrix bavaricus						8						
ANNELIDA:POLYCHAETA												
Manayunkia speciosa												
ACARINA:												

Table L-1. Total numbers (#/$0.025m^2$) of benthic invertebrates from 21 stations in Lake Couchiching

Station	17	17	17	18	18	18	19	19	19	20	20	20
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.06.02	97.06.02	97.06.02	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29
Original % Subsampled	100	50	100	25	25	25	25	25	25	25	25	25
Albia				4								
Arrenurus	1	2	2									
Hygrobates									4	4	8	12
Konikea												
Lebertia			1								12	
Limnesia												
Unionicola												
CRUSTACEA												
AMPHIPODA:												
GAMMARIDAE:												
Gammarus fasciatus							68	52	156			
Gammarus pseudolimnaeus	1	6		12	4	4				8	4	12
HYALELLIDAE:												
Hyalella azteca					12		92	108	244	208	288	364
CLADOCERA:												
CHYDORIDAE:												
Eurycercus												
DECAPODA:												
CAMBARIDAE:												
Orconectes virilis												
ISOPODA:												
ASELLIDAE:												
Caecidotea intermedius												
Caecidotea racovitzai				8	8	12	16	4	16			
Lirceus lineatus							36	12	32		8	4
INSECTA:												
COLEOPTERA:												
ELMIDAE:												
Stenelmis												
DIPTERA:												
CERATOPOGONIDAE:		2	4									4
CHAOBORIDAE:												

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	17	17	17	18	18	18	19	19	19	20	20	20
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.06.02	97.06.02	97.06.02	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29
Original % Subsampled	100	50	100	25	25	25	25	25	25	25	25	25
Chaoborus punctipennis		2	7									
CHIRONOMIDAE:												
CHIRONOMINAE:												
Chironomus				40	8					4	48	24
Cladotanytarsus				16		4				4		4
Cryptochironomus							4					
Dicrotendipes			1	16	16	8		4	16	28	68	48
Microtendipes					16	12						
Parachironomus												
Paracladopelma			3									
Paratanytarsus						8			4			24
Paratendipes	5	2	10	276	224	348	8	12	4	8	32	96
Phaenopsectra flavipes										4		
Polypedilum					4						4	4
Pseudochironomus				72	16	40				8		
Stempellina		2	1									
Tanytarsus	2	2	3	8						4	20	24
Tribelos jucundum												
Zavreleilla												4
ORTHOCLADIINAE:												
Cricotopus									4	20	12	16
Epoicocladius			1									
Psectrocladius			1						4	8		4
Thienemanniella											12	
TANYPODINAE:												
Ablabesmyia	4	8	2		4					4	4	12
Clinotanypus pinguis											4	
Procladius	8	10	32		4						24	4
EMPIDIDAE:												
Hemerodromia								4				
EPHEMEROPTERA:												
BAETIDAE:												

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	17	17	17	18	18	18	19	19	19	20	20	20
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.06.02	97.06.02	97.06.02	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29
Original % Subsampled	100	50	100	25	25	25	25	25	25	25	25	25
Callibaetis											4	
CAENIDAE:												
Caenis punctata				24	36	32				8	12	12
EPHEMERELLIDAE:												
Eurylophella										4		
EPHEMERIDAE:												
Hexagenia limbata	11	18	34									
LEPTOPHLEBIIDAE:												
Leptophlebia												
MEGALOPTERA:												
SIALIDAE:												
Sialis	1	2	1									
ODONATA:												
COENAGRIONIDAE:												
Enallagma sp.												
Enallagma civile												
Enallagma hageni								4	4			
CORDULIIDAE:												
Tetragoneuria cynosura												
TRICHOPTERA:												
HYDROPTILIDAE:												
Orthotrichia												
LEPTOCERIDAE:												
Ceraclea									4		4	4
Mystacides sepulchralis				8								
Nectopsyche albida									4	4	4	4
Oecetis inconspicua-group											4	
Triaenodes												
POLYCENTROPODIDAE												
Polycentropus										4		4
MOLLUSCA:BIVALVIA:												
DREISSENIDAE:												

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	17	17	17	18	18	18	19	19	19	20	20	20
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date	97.06.02	97.06.02	97.06.02	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29	97.05.29
Original % Subsampled	100	50	100	25	25	25	25	25	25	25	25	25
Dreissena polymorpha	3	136	18	4	8		412	236	372	184	260	320
SPHAERIIDAE:												
Pisidium			3			12						
Sphaerium simile												
Sphaerium striatinum												
UNIONIDAE:												
Lampsilis radiata												
MOLLUSCA:GASTROPODA:												
ANCYLIDAE:												
Ferrissia												
HYDROBIIDAE												
Amnicola limosa		2		24	8	24	12	4	4	8	28	28
Cincinnatia cincinnatiensis												
Probythinia lacustris												
PHYSIDAE:												
Physella gyrina							8	4	44			4
PLANORBIDAE:												
Gyraulus circumstriatus						4		4	24			4
Helisoma anceps												
Promenetus exacuous									8			12
VALVATIDAE:												
Valvata tricarinata			1		4	16	16	28	44	4		4
VIVIPARIDAE:												
Viviparus georgianus				4		4	56	16	88			
NEMATODA:	1		10	4								4
PLATYHELMINTHES:												
Dugesia tigrina								4			4	
Hydrolimax griseus	1		1							4	4	4
Total Number of Taxa	10	13	19	20	19	19	16	16	25	21	28	28
Total Number of Specimens	37	194	135	580	400	556	758	500	1104	532	884	1060

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	21	21	21
Replicate	1	2	3
Date	97.06.02	97.06.02	97.06.02
Original % Subsampled	25	25	50
TAXA LIST			
ANNELIDA:HIRUDINEA			
ERPOBDELLIDAE:(juveniles)			
Mooreobdella fervida			
Nephelopsis obscura			
GLOSSIPHONIIDAE:			
Alboglossiphonia heteroclita			
Desserobdella phalera			
Glossiphonia complanata			
Helobdella elongata			
Helobdella fusca			
Helobdella triserialis			
ANNELIDA:OLIGOCHAETA			
ENCHYTRAEIDAE:			
NAIDIDAE:			
Nais communis			
Ophidonais serpentina			
SPARGANOPHILIDAE:			
Sparganophilus eiseni		4	2
TUBIFICIDAE:			
Immatures with hairs		4	
Immatures without hairs		4	
Aulodrilus pigueti			
Aulodrilus pluriseta			
Ilyodrilus templetoni			
Limnodrilus claparedianus			
Limnodrilus hoffmeisteri			
Potamothrix bavaricus		16	
ANNELIDA:POLYCHAETA			
Manayunkia speciosa			
ACARINA:			

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	21	21	21
Replicate	1	2	3
Date	97.06.02	97.06.02	97.06.02
Original % Subsampled	25	25	50
Albia			2
Arrenurus			
Hygrobates		4	
Konikea			
Lebertia			
Limnesia			
Unionicola			
CRUSTACEA			
AMPHIPODA:			
GAMMARIDAE:			
Gammarus fasciatus			
Gammarus pseudolimnaeus			
HYALELLIDAE:			
Hyalella azteca	108	64	26
CLADOCERA:			
CHYDORIDAE:			
Eurycercus			
DECAPODA:			
CAMBARIDAE:			
Orconectes virilis	4		
ISOPODA:			
ASELLIDAE:			
Caecidotea intermedius			
Caecidotea racovitzai			
Lirceus lineatus			
INSECTA:			
COLEOPTERA:			
ELMIDAE:			
Stenelmis			
DIPTERA:			
CERATOPOGONIDAE:	4	8	2
CHAOBORIDAE:			

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	21	21	21
Replicate	1	2	3
Date	97.06.02	97.06.02	97.06.02
Original % Subsampled	25	25	50
Chaoborus punctipennis			
CHIRONOMIDAE:			
CHIRONOMINAE:			
Chironomus	28	4	2
Cladotanytarsus	4	4	
Cryptochironomus			
Dicrotendipes	64	28	18
Microtendipes			
Parachironomus			
Paracladopelma			2
Paratanytarsus	4	4	2
Paratendipes	24	12	16
Phaenopsectra flavipes			
Polypedilum		4	
Pseudochironomus		4	
Stempellina		4	4
Tanytarsus	36	28	4
Tribelos jucundum			
Zavreleilla			
ORTHOCLADIINAE:			
Cricotopus	4		
Epoicocladius			2
Psectrocladius	4	8	2
Thienemanniella			
TANYPODINAE:			
Ablabesmyia	8	16	12
Clinotanypus pinguis	4	4	
Procladius	24	20	28
EMPIDIDAE:			
Hemerodromia			
EPHEMEROPTERA:			
BAETIDAE:			

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	21	21	21
Replicate	1	2	3
Date	97.06.02	97.06.02	97.06.02
Original % Subsampled	25	25	50
Callibaetis			
CAENIDAE:			
Caenis punctata	68	52	34
EPHEMERELLIDAE:			
Eurylophella			4
EPHEMERIDAE:			
Hexagenia limbata	4		24
LEPTOPHLEBIIDAE:			
Leptophlebia			
MEGALOPTERA:			
SIALIDAE:			
Sialis			2
ODONATA:			
COENAGRIONIDAE:			
Enallagma sp.			
Enallagma civile			
Enallagma hageni			
CORDULIIDAE:			
Tetragoneuria cynosura			
TRICHOPTERA:			
HYDROPTILIDAE:			
Orthotrichia			
LEPTOCERIDAE:			
Ceraclea		4	
Mystacides sepulchralis			
Nectopsyche albida	4	4	
Oecetis inconspicua-group	8	4	
Triaenodes			
POLYCENTROPODIDAE			
Polycentropus	4		
MOLLUSCA:BIVALVIA:			
DREISSENIDAE:			

Table L-1. Total numbers (#/0.025m^2) of benthic invertebrates from 21 stations in Lake Couchiching

Station	21	21	21
Replicate	1	2	3
Date	97.06.02	97.06.02	97.06.02
Original % Subsampled	25	25	50
Dreissena polymorpha	344	284	118
SPHAERIIDAE:			
Pisidium			2
Sphaerium simile			
Sphaerium striatinum		4	
UNIONIDAE:			
Lampsilis radiata			
MOLLUSCA:GASTROPODA:			
ANCYLIDAE:			
Ferrissia			
HYDROBIIDAE			
Amnicola limosa	40	28	4
Cincinnatia cincinnatiensis			
Probythinia lacustris			
PHYSIDAE:			
Physella gyrina	4		
PLANORBIDAE:			
Gyraulus circumstriatus			
Helisoma anceps			
Promenetus exacuous	8		
VALVATIDAE:			
Valvata tricarinata			
VIVIPARIDAE:			
Viviparus georgianus			
NEMATODA:			
PLATYHELMINTHES:			
Dugesia tigrina			
Hydrolimax griseus			
Total Number of Taxa	23	27	22
Total Number of Specimens	804	624	312